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Manual's End*

"He bringeth the wind out of his treasuries."

The most fundamental, and perhaps the most fascinating, meteorological study is the study of the wind, and that may be the reason why the first part of the "Manual of Meteorology" to be issued was "The Relation of the Wind to the Distribution of Barometric Pressure," and with "Pressure and Wind" the Manual is now "ended" to use the author's own term which is, as usual, more accurate and satisfying than the common "completed." This volume, written with the assistance of Miss Austin, is, in fact, a revised edition of the original Part IV with two further chapters at the beginning, much of them on the meteorological "fringe," and two at the end summarising the hypotheses and realities and the "prospectivities" now within our ken.

The wind bloweth where it listeth and we cannot change its will—but what is the character of its blowing? whence does it come? whither does it go? and what is its relation to pressure? are questions to which we may find answers, not final, but good answers, in this book.

The plain man will find the first two chapters difficult in their

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**Manual of Meteorology. Vol. IV. Meteorological Calculus: Pressure and Wind:* by Sir Napier Shaw, LL.D., Sc.D., F.R.S., with the assistance of Elaine Austin, M.A. 8vo. 10½ × 7¼ in. pp. xx + 359 + xii, *Illus.* Cambridge University Press, 1931, 30s. net.

(97311) 107/27 1,100 2/32 M. & S. *Gp.303*

technical parts—the meteorologist will find the plain statements in them whipping him out of his orthodoxical ease. The author is indeed an artist—or a wizard. In Chapter I, although the reader may feel inclined to grumble at first, he is drawn on in spite of himself from Newton's and other laws of motion through the law of dynamical similarity, Maskelyne-and-Devant-ish in the tricks it performs, to the Tay Bridge disaster—responsible for more things than the tragedies of Hatter's Castle, among them (the things, not the tragedies) being the pressure tube anemometer; and with the ribbons woven by this instrument—surely more fascinating than any in the bunch which Johnny promised long ago to buy—the chapter closes.

Back from romance, Chapter II, calls the reader to consider the equations of motion of a parcel of air—eventually in a free atmosphere on a rotating earth—equations mainly non-integrable but still fundamental; and then the author, after inserting a " Skippers' Guide " for very learned skippers, glides back to Halley and the Trade winds, to Helmholtz and Atmospheric Billows, to Ekman and his spiral, turning the sea from the wind as a mermaid might (how enthusiastically I greeted her in *Nature* in 1908, and how severely I was rebuked for putting my trust in Ekman's theory and Nansen's drift, and for " pushing the theory off the solid ground of nature "). The chapter is not ended, for later on the reader will need some cheques on Sol and Co.; and eddy-viscosity, with which we English proudly name the name of Taylor, is also " motion of parcels of air " and has its special equations and its variable coefficients. A short reference to Gião's effort to solve the mathematical problem by an initial elimination of the main difficulties leads appropriately to a review of the contribution of mathematical analysis to dynamical meteorology—in this there appears to be a need for " clarifying the situation "—some of the objections which the author raises to the use of meteorological theory (*e.g.*, the absence of real discontinuities of temperature and wind) apply if there is only micro-mathematics, but do they apply if there is macro-mathematics—and does not the geostrophic wind prove the applicability of macro-mathematics to the atmosphere? A remark on p. 77, " the assumption that the motion of the air is horizontal may lead to serious misconceptions," is related to the history of R.101—it is surely by now an assumption which no meteorologist worthy of the name would consciously make except in conditions in which he knew there was no practical possibility of vertical motion. The chapter ends with a simple exposition of the gradient, geostrophic and cyclostrophic winds and tables for their computation.

In Chapter III, the facts of wind near the surface—at " the foot of the structure "—are related to the horizontal pressure gradient. Reference is made to notable exceptions to the rule that the wind at 2,000 feet agrees with the theoretical value derived from the pressure gradient—the investigation of such exceptions will be more profitable to meteorologists than the accumulation of 999,999 values which obey the rules—and, perhaps, it would bring more joy in the presence of their angels.

In the section devoted to winds over the sea, the reader feels that he is floundering about with unsatisfactory estimates—made at the wrong times—for comparison with gradients estimated from insufficient data—and in fact the author is conscious of and apologises for this inadequacy, "but the importance of the subject is itself the excuse for making what use is possible of the material that is at hand in the hope that more may be forthcoming." The records from the anemometer on the Bell Rock lighthouse may go some way towards filling the gap, but meteorological ships—with no outside duties and with real meteorologists—observing according to a well-planned scientific scheme, with instruments designed for the purpose, would add more in a few weeks to our knowledge of the relation between wind and pressure over the sea than the above-mentioned number of estimates by observers whose main work and interest is in other things.

Chapter IV treats of turbulence near the surface, and the effect of this on the variation of wind with height is discussed at some length. In connexion with this chapter it is worth repeating that the wind near the surface is not strictly a gradient wind at all; the pressure gradient at the surface and the force of the earth's rotation—the mass forces—do not directly affect in measurable degree the surface wind. This is effectively determined by the balance between the surface friction and the tangential stress due to the transfer of momentum from above. (The momentum available for transfer is determined by the pressure gradient [or determines the pressure gradient] in the layers where turbulence is small). This important fact was stated explicitly by Whipple in 1920; it, and the corresponding fact (or assumption) that the friction at the surface acts in the line of motion, could with advantage be emphasised in the development of this chapter. None the less, the detailed account here given of the theoretical development and the table of values of the eddy-coefficients will save many a meteorologist hours of searching in the haystacks of scientific periodicals for the formulæ or value which he wants.

Chapter V.—Gustiness and Cloud Sheets.—Why this mating of the unstable and the stable? Because, reader, that is the way to stimulate your curiosity, and you will be able to satisfy it with the facts of the anemometer records and the wedding ring of eddy-viscosity and some charming pictures of the lady and her ring taken in France in August, 1918, a week after Rawlinson's confident and inspiring "Thank you, that is exactly what I wanted to know "—knowledge made possible only by upper-air temperatures read on the aeroplanes on which the photographs were taken for their purely scientific interest; the temperatures are forgotten, the photographs are of the stuff of eternity.

Chapter VI describes the facts of the variation of wind with height up to the stratosphere and even in the stratosphere—about the latter we know far too little, practically nothing at all for those occasions when the troposphere is moving rapidly. The comparative quiescence of the stratosphere is, probably, merely apparent; one conclusion is certain, viz., with a relatively quiet troposphere and stratosphere *ballons-sondes* may sometimes be observed with a theodolite up to heights of 20 Km. or more, and the winds in the stratosphere on such occasions are similar in magnitude to those in the troposphere.

In Chapter VII the relation between the variation of wind with height and the distribution of temperature is treated theoretically and illustrated by examples. One of the most interesting examples comes actually in the next chapter. It is the case of the drift of the Zeppelins on October 19th, 1917, when a west-east gradient of temperature was associated with an unusual increase in the northerly component of the wind at heights above 12,000 feet. In connexion with the variation of gradient wind with height, there is an interesting result, not actually mentioned in the Manual, but attractive for its simplicity; it is this: If T and t are temperatures and P and p pressures at the surface and at height Z respectively, and ϕ and ψ are the angles between the isotherms and the surface and upper isobars respectively, then the ratio of the upper geostrophic wind at height Z to the surface geostrophic wind is simply :—

$$t \operatorname{cosec} \psi / T \operatorname{cosec} \phi$$

and ϕ and ψ are related by the approximate equation $\sin(\phi-\psi)/\sin\psi = y(P-p)/xT$ where y and x are the distances between successive isobars and isotherms.

Chapter VIII is concerned with stream lines of flow and includes examples of Bjerknes' work in this field, and a note of the connexion of these lines with the art of gliding. In this chapter, too, the tephigram is introduced as an aid in tracing the expenditure of energy in the atmosphere—the spending of the money obtained by cashing cheques on Sol and Co. The author's suggestion on p. 221 for the use of observations with pilot balloons in the study of wave-motion by a comparison with the patterns of Bjerknes' diagrams is very attractive.

Chapter IX—Curved Isobars—takes the reader back to the combination of hard mathematics and romance. After a short discussion of the case of a cap of air covering the polar regions and revolving like a solid about the polar axis, the author proceeds to the fascinating subject of secondaries. The simple idea of a secondary as a revolving mass of air moving forward as it revolves, in the same way as a penny would on the map if it rolled along an isobar, is shown to require modification owing to the effect of the earth's rotation. In consequence of this effect, the centre of the isobars is moved a distance $r/(1 + c \operatorname{cosec} \phi)$ from the centre of the " penny," where $r\zeta$ is the rate of travel of the secondary, ζ and ω the angular velocity of the penny and the earth, ϕ the latitude and c is $\zeta/2\omega$; and a further result of interest is that the gradient wind computed from curved isobars is correct, not for the point at which the gradient is taken, but for a point at a distance $cr/(c+\sin \phi)$ to the left of the wind. A natural consequence is that the isobaric centre is not the place of calm.

If the reader thinks he is now done with revolutions Chapter X will disillusion him. Here he will find theoretical discussion of revolving fluid illustrated by selected examples from the atmosphere itself and the records of anemometers and microbarographs which have passed through revolving masses of air. After this he may be surprised (or relieved) to learn the author's conclusion that the study of trajectories of air is of more importance for meteorological practice than the dynamics of revolving fluid. But there it is, at the beginning of Chapter XI, which is consequently devoted mainly to fronts etcetera—that " etcetera " on p. 287 startled me—was it only the abbreviation " etc." which was mildly corrigible long ago? But the account which the author gives of the development of the " fronts etcetera " on pp. 285-91 is excellent. It is, except for a reference to " this tachistocratic* age," written in language which any well-educated person can understand, and includes a number of vivid mental pictures of the various processes involved in the partially idealized development; here is one: " The cold front is the dominant element of the partnership; it invades the warm front from the north and turning eastward continues its invasion until it has reached and overlapped the eastern portion of the polar front with the easterly wind north of it (somewhat diverted from its normal direction) and thereby isolates the portion of the equatorial air nearest the centre of the cyclone. It thus secures the ' occlusion ' of the cyclone. Access of equatorial air along the surface being denied, the cyclone perishes." This eleventh chapter is almost a book in itself—the reader is led from Margules, through Lempfert and Corless, Bjerknes, Van Ryd and the Russians and Japanese back to tradition, and to the cyclone as the " primary expression of atmospheric energy," while the anticyclone is rejected from " the position of prominence which it used to occupy in the dynamics of the atmosphere." All this is naturally mainly a repetition of considerations explicit or implicit in earlier pages of the Manual, but their collection and examination are necessary to round off the picture.

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*" ruled by the speediest " E.G.

The last chapter, " Retrospective and Prospective," is meditational. It contains a brief general survey of the whole work and a suggested synthesis of the general circulation, clear and lucid in the " hypothesis " on page 327, but obscure in the " reality " on p. 326, which calls from the recesses of memory Theseus' generous words: " The best in this kind are but shadows."

When I think of this volume as a whole, the impression left on my mind is not of an ordered logical development of a theory of atmospheric motion—such a development might have been more acceptable to the critic, whom the author disarms so winningly in his preface. There is order and logic and development; but I think rather of the author as inviting the reader to make a journey to the mountain peaks of his ambition and turning him aside at times to explore the valleys and the foothills; and occasionally the interest of the valley seems to hide the distant peaks. They are never reached, being, indeed, unattainable, but they are always being brought nearer and the journey proves of absorbing interest and, though it takes more time, it is free from the weariness of the long straight road. Or again I think of a wonderful palace with the rooms all arranged and full of objects of use and of beauty and of great variety, and of some objects of whose presence I cannot as yet apprehend the reason; all the rooms are different, but, as I go from room to room gradually I realize that there is a unity—partly real, intentional, partly mystic—among this great variety, and that it is a far more inspiring and interesting unity than the unity of an unrolling silken thread or golden cord—of an ordered, logical theory.

My survey is ended; the book is a fine example of courage—it required some courage to write Part IV fourteen years ago and to begin it with a reference to Part I, Chapter V, not published then nor for another seven years—it required some courage to begin this volume with a discussion of the elusive quantity (or value?), " force "—but it required courage of a rarer quality to undertake, and to bring to fruition in the eighth decade of a strenuous life, this great Manual of Meteorology—full of wise guidance and fertile ideas for the rising generation of meteorologists; and for " such as are of riper years " too, but in their case with the addition of happy memories. I find these words (of the Duke of Vienna) quoted in Barrie's " Courage," and they are apt enough to express what is in my mind on this fair day of Candlemas about the spirit which has inspired the Manual:—

" Heaven doth with us as we with torches do
Not light them for themselves . . . . ."

E. GOLD.

Surface Horizontal Visibility with Saturated Air

By S. E. ASHMORE, B.Sc.

At the end of a paper on "The Occurrence of Fog with unsaturated air at Grayshott," recently communicated to the Royal Meteorological Society, I briefly discussed the problem complementary to it, namely, the occurrence of good visibility with saturated air. The suggestion for doing this came from a remark made by Dr. F. J. W. Whipple during the discussion consequent upon the reading of Mr. W. H. Pick's paper, "A note on the Relationship between Fog and Relative Humidity."* The remark was that "one gets intensely high relative humidity and no fog." The method used was to take cases of very good visibility (L and M according to the scale used in the Meteorological Office, see Table I†) alone, and to examine their distribution through various humidity ranges. The conclusion drawn was that very good visibility can occur with high relative humidity, but that it is usually associated with drier air. This treatment is rather inadequate, and the following is the result of the converse treatment of the subject, effected by taking all the cases of saturated air over a period, and examining the visibilities accompanying them.

After having begun the work, I received a copy of Mr. Pick's paper, "Visibility with Saturated Air," read to the Society on December 16th, 1931, which treats the same problem for Felixstowe and Worthy Down. Through the courtesy of Mr. Pick I have been permitted to remodel my investigation on his.

Relative humidity at Grayshott is determined by dry- and wet-bulb thermometers exposed in the usual manner in a Stevenson screen. The criterion of saturation used was that of relative humidity over 99·5 per cent. Every occurrence of this was tabulated for the eight years, 1924-31, observations being made at 9h. daily; cases open to doubt, owing to trouble with the wet-bulb due to frost, have been excluded. The scale of visibility used is that employed in the Meteorological Office, London. It was at first intended to treat winter and summer separately, but analysis showed that in the eight years only six cases of saturated air occurred at 9h. during the summer months (April to September).

Reference to Table I, where comparison is made between the three stations, Felixstowe (coastal), Worthy Down and Grayshott (inland rural), shows that all degrees of visibility, except X, L and M, occur with saturated air at Felixstowe and Worthy Down, but at Grayshott A does not occur. A has never been recorded at 9h. at Grayshott since observations began in 1923. It is well to mention that on a day just outside the

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*London, *Q J.R. Meteor. Soc.* 57, 1931, p. 288.

†See also *London, Meteor. Office, The Observer's Handbook,* 1926, p. 54.

period under investigation, November 9th, 1923, L was recorded with air 100 per cent. saturated. Worthy Down shows a maximum at visibility E, while Grayshott and Felixstowe have a maximum at D, a secondary maximum at F, and a tertiary maximum at J or K. It appears that saturated air tends to produce fog or poor visibility, but that good visibility can occur, more so at Grayshott than at the other two places. Table II shows the data for Grayshott grouped under headings fog (visibility A-E), mist (F), moderate visibility (G-I), good visibility (J-M).

Station	**No. of occasions of saturated air when visibility was**												
	x-A <55 yds.	**B 55 yds.**	**C 110 yds.**	**D 220 yds.**	**E 550 yd .**	**F 1100 yds.**	**G 1¼ mi.**	**H 2½ mi.**	**I 4⅓ mi.**	**J 6¼ mi.**	**K 12½ mi.**	**L-M 18⅔ mi. or more**	**Total**
Grayshott.. ..	**0**	**4**	**34**	**41**	**31**	**38**	**7**	**7**	**5**	**1**	**5**	**0**	**173**
Felixstowe ..	**10**	**23**	**31**	**37**	**23**	**33**	**22**	**15**	**5**	**8**	**0**	**0**	**207**
Worthy Down ..	**4**	**16**	**29**	**23**	**33**	**19**	**23**	**23**	**13**	**11**	**2**	**0**	**196**

TABLE I.

No. of cases of saturated air	Percentage No. of such occasions accompanied by			
	Fog A—E	Mist F	Mod. visibility G—I	Good visibility J—M
173	63·6	22·0	11·0	3·5

TABLE II.

The inference from Table II seems to be that saturated air is usually accompanied by fog or mist, but that neither may occur with it. Only 14·5 per cent. of cases of saturated air were unaccompanied by fog or mist. This does not agree at all well with Mr. Pick's results for Felixstowe, or even for Worthy Down. At the former station 24 per cent. of cases were unaccompanied by fog and mist, and at the latter, 41 per cent.

Table III shows the effects of wind speed on visibility accompanying saturated air :—

Wind force (Beaufort)	No. of occasions of saturated air	No. of such occasions accompanied by			
		Fog A—E	Mist F	Mod. vis. G—I	Good vis. J—M
Calm 0	43	31	4	5	3
1	69	41	19	7	2
2	33	24	8	1	0
3	20	13	3	4	0
4	3	1	1	1	0
5	5	0	3	1	1

TABLE III.

Table III shows that when saturated air is accompanied by wind forces 0, 1, 2 or 3 on the Beaufort Scale, the most likely state of the visibility is fog, but this probability decreases with increasing wind speed. With forces 4-6 it is more likely that there will be mist, moderate, or good visibility. This is in fairly good agreement wth the results for Felixstowe and Worthy Down obtained by Mr. Pick.

Discussions at the Meteorological Office

February 1st, 1932.—*Investigations concerning the variations of the general circulation.* By A. Wagner (Geog. Ann., Stockholm 11, 1929, pp. 33-88) (in German). *Opener*—Dr. C. E. P. Brooks.

This paper discusses the differences between conditions during the two ten-year periods, 1886-95 and 1911-20. Since direct comparison of wind velocities is not practicable, the strength of the atmospheric circulation is measured by the distribution of pressure, and its effects by the distribution of temperature and precipitation. The basis of the investigation is the mass of data in "World Weather Records."

In the chart of pressure differences, 1911-20 minus 1886-95, the most noticeable feature is a deepening and extension of the Icelandic low, connected with the deepened Aleutian low by a trough of negative values which practically encircles the globe. There is evidence of a similar trough of negative values in the southern low-pressure belt. In high northern latitudes, pressure has risen, and there is also a broad equatorial zone of increased pressure, most marked in the anticyclonic centres. In other words, pressure contrasts have become accentuated over the whole world, demonstrating an increase in the strength of the atmospheric circulation. This is attributed to an increase in the strength of the incoming solar radiation, which may be due partly to an increased solar constant but mainly to increased transmission by the atmosphere of short wave-lengths.

Mean annual temperature has in general increased over the continents, but over the oceans the increase is counter-balanced by increased mixing due to stronger winds. Thus, although the amount of heat received by the oceans may be greater, the surface temperature is not raised. A stronger circulation carries more heat from low to high latitudes, but the increase is greatest in winter, when the thermal contrasts are greatest. Hence the annual range has increased near the equator and decreased in temperate regions; also the balance between radiation and temperature is changed, so that the extremes of temperature are retarded in low latitudes and advanced in high latitudes, the dividing line occurring where the annual inward and outward radiations balance. Changes in the amount of precipitation also follow changes of pressure, the most notable feature being an increase in the amount of orographic rain.

The author considers that most of the correlations between distant regions found by Sir Gilbert Walker and others are due to connexions with the general circulation, changes in which have considerable persistence. Thus, the general circulation forms the true basis of long-range forecasting, and it may eventually be possible to relate it to solar changes.

The subjects for discussion for the next two meetings will be:—

February 29th, 1932.—*The mixing question, viewed theoretically and practically together with a consideration of internal waves.* Discussions and report by W. W. Ekman, G. I. Taylor and H. Thorade (Copenhagen, Cons. perm. Inter. l'exploration de la Mer. Rapports et Procès Verbaux des Réunions, Vol. 76, 1931). *Opener*—Mr. E. L. Davies, M.Sc.

March 14th, 1932.—*Essay on the structure of a burst of warm air* (October 16th-18th, 1928). By Hellmut Berg (Beitr. Geophysik, Leipzig, 30, 1931, pp. 1-30) (in German). *Opener*—Dr. W. A. Harwood.

Royal Meteorological Society

The Annual General Meeting of this Society was held on Wednesday, January 20th, at 49, Cromwell Road, South Kensington, Mr. R. G. K. Lempfert, M.A., F.Inst.P., President, in the Chair.

The Symons Gold Medal, which is awarded biennially for distinguished work in connexion with meteorological science, was accepted by the Norwegian Minister on behalf of Prof. V. Bjerknes, of the Physical Institute of the University, Oslo, to whom it had been awarded by the Council.

The Report of the Council for 1931 was read and adopted, and the Council for 1932 duly elected, the new President being Prof. S. Chapman, F.R.S.

Mr. R. G. K. Lempfert delivered an address on: "The Presentation of Meteorological Data," of which the following is an abstract:—

Meteorological data are accumulating with ever increasing rapidity. Our *Daily Weather Report*, for example, contains more than 3,000 facts for British stations in a single issue, and there are also 250 stations in the *Monthly Weather Report* and 5,000 in the British Rainfall Organization. Questions of exposure require great care, for example, a steady decrease of wind velocity shown by the records from Glasgow Observatory may perhaps be due to the activities of Glasgow's builders rather than to meteorological causes. The method of presentation of all these facts is important; summaries are essential, and in this country these are given in the *Weekly* and *Monthly Weather Reports*. Monthly summaries are published according to an international form, the essentials of which were devised in 1874. It is by no means easy to maintain continuity in a series of observations over a long period of years. Changes of procedure, such as the adoption in 1921 of the day maximum and night minimum instead of extremes for 24 hours, can hardly be avoided. Non-instrumental observations present still greater difficulties, yet when such observations are plotted on maps they bring out many interesting climatological relationships. Fog has been especially unsatisfactory in the past, but owing to the demand for precise information for aviation the criteria for fog and visibility have been greatly improved in the past ten years.

Since 1874 many additions have been made to the international summary form, such as information about coldest days and warmest nights, and the number of days with rainfall, temperature or sunshine between specified limits. The more general use of autographic instruments suggests that the idea of duration between specified limits which has already been introduced into the presentation of statistics of wind might be extended with advantage to other elements, more particularly to the element, humidity, for which the present summaries of observations at 9h. and 21h. give an ineffective representation. Some specimen tabulations of the duration of humidity are far more informative. A distinguished botanist has suggested that the " saturation deficit " should be given, and a specimen table for one week was shown, which illustrated clearly how regularly the deficit fell below 6mb. during the night hours between 20h. and 9h., suggesting that the air has then no appreciable drying power.

Correspondence

To the Editor, *The Meteorological Magazine.*

Solar Haloes and Mock Suns at Cambridge

On January 14th of this year a very striking development of solar haloes and accompanying phenomena was observed from this college. About 1.30 p.m. I saw that the sun, then partly obscured by clouds, was surrounded by an unusually good example of the common halo. Further, on either side of the sun and at the same level, there were two specially bright " mock suns." For a few minutes, about 1.45 p.m., these were so vivid that it was almost painful to look at them directly, and in fact they were nearly as bright as the real and partially obscured sun. Vertically above the real sun there was a small patch on the halo in which the colours were specially clear : red on the concave side of the arc. Concentric with the first-mentioned halo, and with about double the radius, was another exactly similar halo, very faint, but with the colours in the same order : red inside. Touching the highest point of this second halo there was also an inverted bow, in which the colours were extraordinarily vivid, even when seen against an almost clear blue sky. In this case the blue was on the concave side. This bow, which was very short, was as bright as many common raindrop bows, only it was upside down.

I measured with a prismatic compass the radius of the inner halo and found it to be 21-22°, the ordinary ice-crystal halo radius, but I could not get a measurement for the second halo. I estimated it as about double that of the first, and I am told that it should be about 46°. The agreement is good enough.

The notable features seem to be: (1) the brightness of the mock suns; (2) the occurrence of both inner and outer haloes; (3) the brightness of the inverted bow at the top.

The outer halo and the inverted bow disappeared very quickly, but the inner halo, the mock suns and the bright coloured patch above the sun were still faintly visible almost up to sunset.

R. H. RASTALL.

Christ's College, Cambridge. February 3rd, 1932.

Winter Minimum Temperatures on Mountains

In 1923 I placed a thermometer in the cairn at the top of Ben Chonzie (Ben-y-Hone), 3,048 ft., here with a view to recording perhaps some zero or minus temperatures during the winters.

In the nine following winters the following are the minima recorded by this thermometer, to which I have appended the minima at Auchnafree (1,015 ft.):—

	Ben Chonzie.	*Auchnafree.*
1923-4	9	—
1924-5	9	14
1925-6	5	7
1926-7	—	13
1927-8	—	9
1928-9	7	6
1929-30	10	6
1930-1	13	12

The thermometer necessarily has to be built well into the cairn, so as not to be tampered with by tourists or others, and so may possibly be unduly sheltered by snow. At the same time the readings bring out the recognised fact that in very cold weather it is on the low ground and not on the highest spots that minimum temperatures are experienced.

With the temperature at 50° at Auchnafree, that on Ben Chonzie is generally 7-8° lower, and when 30° at Auchnafree, generally 4° lower. At still lower temperatures the difference between the two is less, or none, but it seems that a minus temperature is more likely to occur at Auchnafree than on Ben Chonzie.

J. A. C. WHITAKER.

Auchnafree Lodge, Dunkeld, Perth.

[It may be of interest to add that during the considerable period (1883-1904) in which the observatory on Ben Nevis (4,404 ft.) was in operation the minimum, in a Stevenson screen, never fell below 0°F., though temperatures as low as 2° or 3°F. were experienced in conjunction with winds of over gale force. —A. H. R. GOLDIE.]

Unusually persistent Rain

The following data of the exceptional rainfall recorded here from January 1st-3rd of this year may be of interest to you. The weather during this period was remarkable for four reasons: (1) the persistency of the rain, (2) slight movement of barometer, (3) lightness of wind, (4) continued high air temperature.

Date	*Rainfall*	*Temperature.*		*Wind at 9h.*
		Max.	*Min.*	
	in.	°F.	°F.	
1st	0·83	48·6	44·2	SW. 3
2nd	2·09	51·6	48·6	SW. 2
3rd	1·17	54·6	51·6	SW. 2

The total fall for the 72 hours was 4·09 in.

As reported in newspapers there was severe flooding in the Clyde Valley and surrounding districts.

It will also be noted that the temperature rose continuously from 44·2° at 21h. on December 31st to 54·6° at 11h. on January 3rd. The barograph trace showed a drop of 0·43 in. from 12h. on the 31st to 8h. on the 1st, thereafter it remained constant to 10h. on the 3rd, showing the diurnal variation in that period, the average being 29·56 in.

KENNETH M. TOPPING.

71, Gala Street, Riddrie, Glasgow. January 10th, 1932.

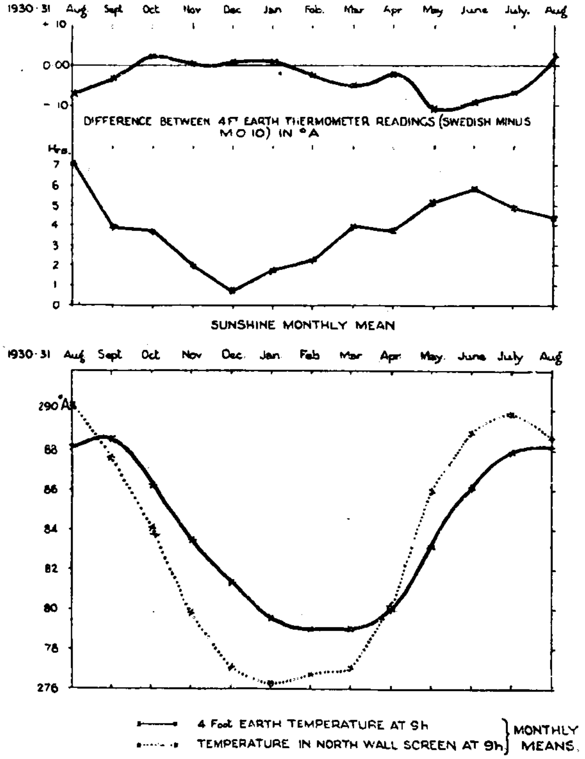
NOTES AND QUERIES

Note on a comparison between readings of two 4-ft. earth thermometers

The records of earth temperatures at meteorological stations in this country are usually derived from Symons thermometers. These are ordinary mercury thermometers with their bulbs covered by paraffin wax and protected by glass jackets. Strong iron tubes with closed pointed ends are driven into the ground and the thermometers are hung by chains so that the bulbs may be at the prescribed depths, usually 1 ft. or 4 ft. below the ground level. The tops of the tubes are covered by caps mounted on wooden plugs, which fit loosely and to which the chains are attached.

At Kew Observatory there are two 1 ft. thermometers of this type, and one 4 ft. The thermometers are read at 9h. The paraffin lags the thermometers efficiently, so that no error can be introduced by bringing them up to the open air. The thermometers are graduated on the Absolute (Integral Freezing Point) scale. The 4 ft. thermometer requires (according to the N.P.L. certificate, dated 1913) corrections +0·1° at 273° and at 290°, + 0·2° at 280°. It has been customary to apply the correction +0·2° to readings up to 285° and the correction +0·1° to readings above that limit.

In the summer of 1930 a 4 ft. thermometer of the type which has been devised in Sweden by A. Angström and E. Petri was sent to Kew Observatory by the Meteorological Office for trial. The Swedish pattern differs from the Symons in several respects. A smaller thermometer is used, and instead of the bulb being surrounded by paraffin wax it is in a vacuum. According to the diagram issued by the makers the clearance between jacket and bulb is about 1 mm. There is a thick coat of enamel paint outside the jacket. The temperature reading rises pretty rapidly when the thermometer is held in the hand, but it is unlikely that readings would be affected in the ordinary routine. In place of the iron tube a vulcanite tube of much smaller bore is used. At the bottom of the tube there is a copper shoe, inside which is a small rubber cushion. The thermometer jacket, which is a little less than 1cm. in diameter, passes readily down the tube. The thermometer is attached to a cord from a button which rests on top of the vulcanite and a metal cap screws on to the vulcanite and covers the button. No certificate was received with the thermometer, which is graduated in half degrees Fahrenheit. Comparison with the Kew standard thermometer, M.O. 514, gives the correction +0·5° F. After application of this correction, the daily readings of the Swedish thermometer have been converted to °A and compared with those of Kew standard thermometer M.O. 10.



In the first instance the corrections mentioned above were applied to the readings of thermometer M.O. 10, but it was realised that the discontinuity in the correction at 285° was misleading and a flat correction of +0·1° was substituted. On this basis the agreement between the two thermometers is very satisfactory. The difference in readings (Angström-Petri minus Symons) varies from −0·2° to +0·2°. In the 12 months September, 1930-August, 1931 −0·2° occurred 17 times in March to July and once in November, whilst +0·2° occurred twice in August. The monthly means fluctuate between −0·11° and +0·02°.

As will be seen from the graph there is close agreement from October to April, but a discrepancy of 0·1° A appears in May, June and July. In these months the Symons thermometer gives the higher reading. The differences are consistent with the hypothesis that heat conducted down the iron tubes raises appreciably the temperature at 4 ft. during the hottest months. The excess is of the order 0·1° A or 0·2° F.

The comparisons under review do not serve for the estimation of such small differences, as the calibration of the thermometers is not sufficiently precise. It is therefore being arranged that one thermometer, the Swedish one, shall be placed on alternate days in one tube or the other. Preliminary readings indicate that in November with temperature falling from day to day the iron tube gives lower readings at 4 ft. than the vulcanite tube. The difference is 0·1° F.

It appears to be desirable to conduct the comparison on these lines for a year before assessing the advantage of the substitution of vulcanite for iron. One lesson learned from this investigation may be emphasized. For such work it is not desirable to apply thermometer corrections in such a way that the corrections change at points selected by some arbitrary rule. It is better to apply uniform corrections and, if necessary for the purpose in hand, make adjustments in final results.

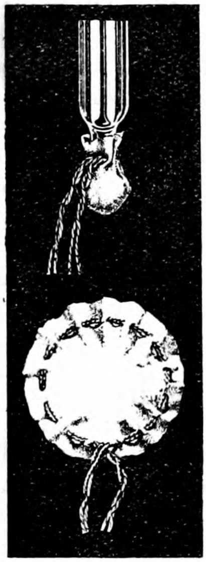
Changes in Italy

On November 1st, 1931, Professor Luigi Palazzo retired from the Directorship of the R. Ufficio Centrale di Meteorologia e Geofisica. Professor Palazzo joined the Italian Meteorological Office in 1888 and became Director in 1900. He has been succeeded by Professor Comm. Emilio Oddone, the senior Geophysician.

Professor Giovanni Agamennone, having reached his 73rd year, retired on November 1st, 1931, from the post of Director of the R. Istituto Geofisico di Rocca di Papa, Rome, which he has held for 32 years and also from the post of Head of Geophysics at the R. Ufficio Centrale di Meteorologia e Geofisica, which he has held for two years.

Muslin caps for wet-bulb thermometers

Acting on a suggestion by Dr. E. Kidson, Director of the Meteorological Service in New Zealand, a trial has been made of muslin caps for fitting to wet-bulb thermometers in place of the muslin and wick which has been used in the past for this purpose. The trial having proved satisfactory the method has been adopted by the Meteorological Office and issues of these caps can now be made to private observers who desire to purchase them. The caps are supplied in packets of 20 at 1s. per packet. They are, however, readily made, and as observers may in many cases prefer to make them up from the muslin and wick supplied by the Meteorological Office instead of buying them, the following instructions are given :—



A circular piece of muslin should be cut 1½ inches in diameter. Two threads of wick should then be threaded round the muslin about ⅛ inch from the edge in the manner shown in the illustration the thread being pulled through so that the four loose ends are of equal length. The cap is then ready for use. When fitting it to the thermometer bulb it should be placed over the bulb and the threads pulled through the muslin so that the cap is held firmly round the neck. The threads may be left untied, the friction of the thread in the muslin alone being sufficient to prevent the thread from working loose. The loose ends of the thread will be found to be long enough to reach the water container.

Storage of Balloons in Turpentine and Paraffin Vapour

In the *Meteorological Magazine* for January, 1928, Dr. Knox-Shaw gave an account of his successful experience with the preservation of balloons and other rubber goods by storing them in a cupboard in the presence of turpentine vapour.

The storage of pilot balloons is a matter of great importance to the Meteorological Office and it was accordingly decided to carry out a thorough test of this method of storage. In August, 1930, 500 70-inch balloons (*i.e.*, balloons 70 inches in circumference when distended) were placed in a cupboard which was kept saturated with turpentine vapour by a tray of turpentine at the bottom. A suggestion having been received that paraffin vapour might prove more efficacious than turpentine vapour, 100 balloons were stored in a similar way in paraffin vapour. The storage cupboards were placed in a small iron hut, without opening windows or ventilator, on the roof of the Meteorological Office at South Kensington, where they were exposed to considerable fluctuations of temperature and to strong solar heating in the summer. Samples of the balloons both when new and at periodic intervals were issued for test to Croydon and Lympne in this country and also to the stations in the Middle East Area, careful note being kept of their behaviour. Apart from this special note of their behaviour, the balloons were used in the normal way, their use being spread over several weeks from the date of receipt at the station. They were thus exposed to the normal deteriorating effects of air storage for a time after removal from the special storage cupboards. Issues of turpentine vapour balloons were made at intervals of 3, 6, 9 and 12 months after storage and of paraffin vapour balloons at intervals of 6 and 12 months. In the summarized results given below the balloons are classified as bad when they burst before being completely filled or during the early stages of an ascent, and good when they gave a successful ascent. The effect of the different periods of storage in turpentine vapour is shown in the following table:—

	Lympne and Croydon.		*Middle East.*	
	Bad.	*Good.*	*Bad.*	*Good.*
Balloons when new ...	2	40	4	42
3 months' storage ...	4	39	3	42
6 ,, ,, ...	5	40	4	41
9 ,, ,, ...	5	40	6	39
12 ,, ,, ...	9	25	6	30

The figures seem to indicate a marked deterioration between 9 and 12 months in the balloons used in this country, while in Middle East the results after 9 and 12 months showed a much less striking difference. The results obtained in Middle East which indicate 5 serviceable balloons to one unserviceable balloon after 12 months' storage are satisfactory.

The balloons stored in paraffin vapour showed practically no deterioration in England or Middle East when used after 6 months' storage. The figures are given below, together with those after 12 months' storage:—

	Lympne and Croydon.		*Middle East.*	
	Bad.	*Good.*	*Bad.*	*Good.*
Balloons when new ...	2	40	4	42
6 months' storage ...	2	22	0	24
12 ,, ,, ...	3	13	2	12

These results seem to indicate that paraffin vapour is slightly superior to turpentine vapour in its preservative properties. Reports received from the testing stations showed that some of the turpentine vapour balloons when received had their sides stuck together. This seems to have been one of the chief causes of failure.

In addition to the above field tests a few samples were tested in the Meteorological Office laboratory by blowing them up to destruction on the small air blower which is used for testing balloons. This blower fills a standard 70-inch balloon in 30 seconds and the time taken to burst a balloon gives a good indication of its volume at the time of bursting. Good quality balloons will always exceed the nominal circumference, sometimes by a considerable amount. Six of the balloons tested when new gave an average time of bursting of 90 seconds. After 9 months 3 balloons stored in turpentine vapour gave a time of 68 seconds, while 3 stored in paraffin gave 78 seconds. After 12 months the times were: turpentine 87 seconds, paraffin 93 seconds. These laboratory test figures thus show no appreciable deterioration after storage for 12 months.

A few balloons were left in the cupboards for a further period of 4 months. At the end of this time the balloons over turpentine vapour had deteriorated somewhat, but the turpentine had not been renewed for some months and had probably lost its effectiveness. The paraffin vapour balloons gave a bursting time of 82 seconds and were thus practically as good as new.

The general conclusion reached from the experiments is that paraffin vapour is somewhat superior to turpentine vapour and that either is of great value for preserving rubber pilot balloons for a period of 12 months. None of the balloons were kept in air for so long a period as 12 months, but there is little doubt from past experience that before the expiration of this time balloons so stored would have become almost useless.

The High Pressure of January, 1932

For several days before January 20th, pressure remained high on the continent, while depressions skirted the west and northwest coasts, so that a very mild southerly or south-westerly type of weather prevailed. By the 20th the greater part of the country had come under the influence of the continental high, which was periodically re-inforced by a new high spreading in from the west with a consequent shift of the centre of the continental anticyclone towards the British Isles. By the 26th, the anticyclone with its central area over the midlands and North Sea had attained its maximum intensity, so that barometer readings over most of England on this day were the highest for many years. At Ross-on-Wye the reading (1048·5 mb.) was the highest ever known, and at Birmingham (1049·4 mb.) it was a record for the last 45 years. The highest pressures recorded on the 26th were 1050·2 mb. at Cranwell and 1050 mb. at Harrogate. The barometer remained above 1049 mb. in many parts of the midlands and the east coast. It is to be noted that the pressure values given in this note are corrected for temperature and reduced to mean sea level.

After the 26th, pressure fell slightly over the country as the anticyclone, decreasing in intensity, moved slowly south-eastwards to the continent. Later the continental anticyclone moved north-eastwards, increased in intensity, so that by the 31st it was again centred over the British Isles giving a maximum barometric pressure of 1045·9 mb. at Sealand. Anticyclonic conditions continued during the early part of February.

It is recognised that in winter two distinct types of anticyclones occur over the British Isles; in one, the sky is covered with a layer of stratus cloud, conditions which are referred to as "anticyclonic gloom," and in the other, the sky is almost cloudless and the nights are frosty. The first anticyclone of January 25th-27th appears to have both the above characteristics, because on the 25th the south-east sector was completely overcast with stratus clouds, whereas north of a line Cork-Tynemouth the sky was almost cloudless. Due to this anticyclonic gloom in the south-east low maximum temperatures were recorded, 38°F. at Kew being the maximum for the 25th. Similarly, owing to the clear skies of the north-west sector of the anticyclone allowing radiation at night, the lowest screen and grass minimum temperatures were recorded in northern districts, such as a screen minimum of 18°F. at Eskdalemuir and a grass minimum temperature of 12°F. at Catterick on the night of the 25th-26th.

With the movement eastwards of the anticyclone on the 26th, the cloud amount decreased slightly in the south-east but increased in the north owing to the approach of a depression, so that the lowest maxima were recorded in the northern districts: such as 35°F. at Eskdalemuir on the 26th, 32°F. at Stonyhurst on the 27th, and 30°F. at Birmingham on the 28th. The clear skies still persisted on the north-east coast on the 26th, and owing to night radiation the lowest temperatures were a screen minimum of 26°F. and a grass minimum of 11°F. at Catterick.

Fog, however, was much more widespread during the second but less intense anticyclone.

A period of high pressure prevailed over Scotland during the second week of January, 1896, when an anticyclone moved westward from the continent of Europe over the British Isles, where it combined with another anticyclone lying off our north-west coasts, and increased suddenly in intensity. At 8 a.m. on January 9th, the barometer exceeded 1050 mb. over the whole of Scotland, the first appearance of that isobar on our weather charts. The highest reading was 1054·4 mb. at 9 a.m. at Ochtertyre, Perthshire. After the 9th the whole system moved away south-westwards, but a remarkable return of high pressure occurred at the end of the month when the barometer rose to 1048·9 mb. at Valentia, Ireland. A peculiarity of both these anticyclones in January, 1896, was the mild weather associated with them—on both occasions temperature was almost everywhere above freezing point.

W. R. MORGANS.

Reviews

Kentucky Geological Survey. Series 6, vol. 31. The Pleistocene of northern Kentucky, The Climate of Kentucky, and other papers. Frankfort, Kentucky, 1929.

For meteorologists the main interest in this volume of papers from the Geological Survey of Kentucky is in the second contribution, " The Climate of Kentucky," by Dr. S. S. Visher, a profusely illustrated memoir of 85 pages. The state, in an area rather more than two-thirds that of England and Wales, comprises nearly seventy stations, sufficing to give the distribution of the various meteorological elements in some detail, though as the greatest extent is from east to west, the variation is generally small. On the other hand, the charts illustrate clearly the increasing continentality from east to west. Apparently in calculating the average temperatures, no correction is applied for the differences of elevation, ranging from 300 to 1,400 feet. The 109 illustrations include a number showing average dates of killing frosts, vegetative periods for different crops, and much other material of value to farmers. The method adopted is rather unusual; the charts do not so much illustrate the text as run parallel with it, each chart being given a generous legend which makes it self-explanatory. This makes reference easy, which was probably the author's intention, but tends to encourage turning the pages at the expense of steady reading. The paper concludes with an interesting description of the effect of the warm humid climate of Kentucky on the relief of the ground, and especially of the formation of " swallow holes " in limestone country.

India Meteorological Department, Scientific Notes, Vol. II, No 15, *Winds in higher levels over Agra,* by N. K. Sur, D.Sc., *No.* 16, *Winds in the first* 3*Km. over Port Blair*, by K. P. Ramakrishnan, B.A., and No. 17, *Tables of monthly average frequencies of surface and upper winds up to* 3*Km. in India, Parts A, B, C and D.*

The conclusions in the first paper, drawn from the analysis of two years' observations at Agra, are briefly that (i) in the weak winds of the summer monsoon no marked change of speed occurs at the tropopause; but the strong north-westerly or westerly winds of winter, which increase from 1Km. to 14Km., show a marked tendency to decrease from 14Km. to 15Km. Data are, however, scanty at this level. (ii) Up to 14Km. pilot balloons show north-westerly or westerly winds during the whole year, but in vigorous summer monsoons clouds show easterly winds. (iii) The few observations obtained indicate a change from south-westerly to north-easterly winds in the monsoon on entering the stratosphere, and a change from north-easterly to north-westerly through south-west above 20Km.

The author's aim in the second paper was to find with what accuracy wind, and consequently air-trajectories in the neighbourhood of tropical depressions, could be estimated from the pressure gradient indicated by the Indian daily weather charts. Data extending from July, 1926, to June, 1928, were used. The results indicate that monthly mean wind at 0·5Km. and 1Km. agrees fairly well with the gradient wind, but the agreement on individual days is poor. Many of the deviations are accounted for by orography, but there are also deviations due to systematic horizontal temperature gradients in both the winter and summer monsoons.

The four parts of the third paper contain pilot balloon data in the form recommended by the International Commission for Air Navigation. The stations included are:—A—Bahrein, Muscat, Jask, Gwador, Karachi, Quetta, Peshawar, Lahore, Simla and Ambala; B—Ahmedabad, Ajmer, Agra, Jubbulpore, Patna, Ranchi, Calcutta, Dacca, Rangpur and Tezpur; C—Chittagong, Mandalay, Akyab, Rangoon and Port Blair; D—Poona, Waltair, Mangalore, Bangalore, Madras, Trincomalee and Colombo.

Standard Meteorological Instruments, *List M.2*, and *Mercury-in-Steel Thermometers.* Pp. 140 and pp. 40. *Illus.* Negretti & Zambra, London, 1931.

We have received from Messrs. Negretti & Zambra a copy of their latest catalogue of meteorological instruments, which contains almost every kind of such instrument used in this country. Messrs. Negretti & Zambra have spared no pains to make this catalogue not only an attractive advertisement for the sale of their instruments, but they have also produced a book of reference and explanation for all who are interested in those instruments appertaining to the science of meteorologoy.

In drawing up this catalogue Messrs. Negretti & Zambra have studied the interests of the amateur as well as the most exacting observer. For the information, especially of the latter and for those abroad, permission was obtained from the Director of the Meteorological Office to embody in the catalogue extracts from official specifications of the instruments used by the Meteorological Office. The inclusion of instruments made to official specifications is all to the good. Not only does it make the catalogue more comprehensive and enable the interested public to know the kind of instruments used by the Meteorological Office, but there is set before the prospective purchaser, from which he is free to choose according to his needs, a set of instruments ranging from what may be termed the standards for official use, which can be supplied with certificates of accuracy by the National Physical Laboratory, to those that will meet the requirements of the class room.

This is a catalogue for the meteorological observer *par* *excellence* so that instruments often to be observed in the home are absent. It is to be regretted that space could not have been found for an illustration of the up-to-date sunshine recorder used in this country, for this incorporates an adjustable sub-base for accurate levelling and for positioning in the meridian. Some readers may be misled by the name microbarograph, the name given in the catalogue, pages 41 and 42, to the large scale barograph. The term " microbarograph " is reserved by the Meteorological Office for the instrument (not catalogued) designed by Dines and Shaw for recording small and rapid variations of atmospheric pressure, while the barograph with greatly amplified scale, such as that listed in the catalogue, is named by the Meteorological Office, the open scale barograph.

For those interested it should be mentioned that there are included in the catalogue a number of test apparatus for the calibration of thermometers, barometers, aneroids, hygrometers and anemometers.

The catalogue is beautifully printed and profusely illustrated on art paper and handsomely bound. and Messrs. Negretti & Zambra are to be congratulated upon producing a very fine and useful volume.

We have also received from the same makers an illustrated brochure entitled " Mercury-in-Steel Thermometers." This is a revise of their pamphlet " Notes on Distance Thermometers." In it are discussed at some length the relative merits of gas, vapour and liquid distant reading thermometers. The errors inherent in such instruments are frankly stated and examined, and the various methods devised and adopted for overcoming them or reducing them to negligible proportions set forth.

J. E. BELASCO.

Books Received

Falmouth Observatory. Meteorological Notes and Tables for the year 1930. Also additional meteorological tables for the lustrum 1926-1930, with mean values for 60 years (1871-1930) by W. T. Hooper. Falmouth, 1931.

Nautisk-Meteorologisk Aarbog, 1930. The Danish Meteorolgical Institute, Copenhagen, 1931.

Functions and Organisation of the India Meteorological Department (1931). Delhi, 1931.

Brown's Distance Chart. Distances between all the principal parts of the world. Brown, Son and Ferguson. Glasgow, 1931.

News in Brief

We learn that Capt. F. Entwistle, Superintendent of the Aviation Services Division of the Meteorological Office, has accepted the editorship of the *Sailplane*, the journal of the

British Gliding Association. Capt. Entwistle proposes himself to qualify as a glider pilot.

Erratum

January, 1932, p. 288, line 19: *for* " Baltasound, Kirkwall, Orkney," *read* " Halligarth, Baltasound, Shetland."

The Weather of January, 1932

Pressure was above normal over the whole of southern and central Europe, Denmark, Gothaland (Sweden), England, north Africa, and from southern Greenland to the Bermudas and Florida, the greatest excess being 12·9 mb. at Cagliari, and 5·1 mb. at 60°N.60°W. Pressure was below normal in a belt extending from northern Europe and Spitsbergen across Iceland to the central part of the North Atlantic, including the Azores, the greatest deficit being 8·7 mb. at Vardo. Temperature was above normal over the whole of north-west and west Europe and Spitsbergen, as much as 13°F. or more above normal in half Norrland, and below normal in south-west Europe. Rainfall was generally in excess in western Europe, but deficient in northern Norway and Spitsbergen. In Sweden it ranged from double the normal in western Lapland to one-third of the normal in south-eastern Gothaland.

Over the British Isles the weather of January was very mild and unsettled with south-westerly winds until about the last ten days, when it became anticyclonic with temperatures about normal. Rainfall was generally in excess—more than twice the normal in south-west Scotland—but deficient along the eastern coasts of England. During the first two days there was a continuous and rapid rise of temperature as a depression approached from the Atlantic, and the night of the 2nd-3rd was the warmest January night on record at several places; at Tynemouth the minimum temperature was 55°F., at Chester, Liverpool, Donaghadee, Birr Castle, Valentia and Greenwich 54°F. For the next two or three days the weather was mild and stormy with depressions moving north-east along the north-western seaboard. Gales occurred in the west and north-west, sunshine was poor and rain general and heavy at times; 4·16 in. fell at Borrowdale (Cumberland) on the 2nd, 2·10 in. on the 5th, at Oughtershaw (Yorks) 2·18 in. on the 2nd, 2·01 in. on the 5th, and at Llyn Fawr 3·42 in. on the 5th. On the 5th and 6th gales also spread to the south and Midlands, but by the 7th the winds had veered and moderated and the country came under the influence of polar air, bringing snow and sleet to Scotland and north Ireland. The 7th and 8th were both sunny days, Bath and Weymouth both had 6·9 hrs. on the 8th. Subsequently depressions continued to move along the north-west seaboard and very mild weather with south-westerly winds was renewed. Strong winds and gales prevailed frequently, especially in the west and north from the 9th to 19th, and rainfall was heavy at times until about the 14th or 15th, when thunderstorms occurred generally in the west; at Holne (Devon) 4·15 in. of rain fell on the 9th, 2·87 in. on the 12th, at Borrowdale 3·81 in. on the 9th, and at Goytre Hall (Monmouth) 2·89 in. on the 9th. Sunshine records were good on many days, the sunniest days being the 12th and 15th. On the 18th, day temperature reached 60°F. at Llandudno, 59°F. at Dunbar, York and Bude. About the 20th the continental high-pressure area spread westward, and anticyclonic conditions set in and persisted until the end of the month. Some record high-pressure readings were registered.* Mist or fog occurred frequently on most days and sunshine was therefore rather variable but good at times. The 21st, 24th (only in the north), 25th and 30th were the sunniest days, 8·0 hrs. at Dover on the 21st and 7·9 hrs. at Eskdalemuir were the biggest amounts reported. There was slight rain or drizzle locally except in the eastern districts. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	20	— 8	Liverpool	58	+ 3
Aberdeen	72	+24	Ross-on-Wye	48	+ 2
Dublin	57	0	Falmouth	46	—12
Birr Castle	41	— 8	Gorleston	55	— 1
Valentia	29	—19	Kew	38	— 5

The special message from Brazil states that the rainfall there was irregular in the northern regions with 0·12 in. above normal, very plentiful in the central regions with 1·06 in. above normal, and scarce in the southern regions with 1·34 in. below normal. The crops were affected by the small rainfall, but the yields of cotton and cane were good. Five anticyclones passed across the country. At Rio de Janeiro pressure was 2mb. above normal and temperature 1·6°F. below normal.

Miscellaneous notes on weather abroad culled for various sources.

At the beginning of the month the weather was cold but fine in northern Italy and cold and stormy in central and southern Italy; the hills round Rome were covered with snow on the 1st, skiing was possible in Sicily on the 3rd, and gales caused shipwrecks in the Adriatic. The whole surface of the harbour of Shibenik on the Dalmatian coast of the Adriatic was frozen over on the 3rd, and several deaths due to the unusual cold occurred in Catalonia, while communications were interrupted in Hungary owing to the heavy snowfall on the 2nd. Heavy rain on the 6th and 7th caused a rise of the Meuse and its tributaries.

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* See p. 18.

Florence was enveloped in fog over the 16th and 17th, which is unusual, and fog was experienced in Rome on the 17th. Severe gales occurred near the Faroes on the 17th, causing much damage to ships. Mild weather was experienced in Stockholm about the 25th. (*The Times*, January 2nd-26th, 1932.)

Many villages in the Cape Midlands (South Africa) were still isolated early in the months by the floods which occurred at the end of January. These did much damage to farms and railways. Unusually wet, cold and snowy weather prevailed in Algeria at the beginning of the month and in consequence a landslide occurred near the Palestro Gorges on the 13th. (*The Times*, January 4th-15th, 1932.)

A hurricane swept across Bali and Lombok, two islands in the Dutch East Indies, at the beginning of the month and 13 people were drowned in the swollen rivers. (*The Times*, January 8th, 1932.)

Great heat was experienced in New South Wales during most of the month and numerous and widespread fires broke out, doing much damage. At Sydney a temperature of 106°F. was reported and two people died of the heat. At the end of the month several towns in the State suffered from violent storms. (*The Times*, January 5th-23rd, 1932.)

About the 14th, while most of the prairie country was suffering from low temperatures, the Central Province of Canada were enjoying almost summerlike weather with the thermometer about 50°F. At the same time a heat wave passed over New York, where a temperature of 68°F. was registered on the 13th and 14th, which is a record there for January. Eleven people were killed and over 100 injured in a tornado which swept the Alabama-Mississippi border on the 12th. The floods caused by the overflowing of the Mississippi, Tallahatchie and Yazto Rivers extended for a distance of 200 miles on the 17th. Twenty thousand Indians in their villages in the canyons and mesas of western New Mexico were cut off from civilization by one of the heaviest snowstorms ever known there about the 17th. Temperature was considerably above normal over the United States throughout the month, except in parts of the Mountain Region and along the Pacific coasts. Along parts of the Atlantic coast it was more than 20°F. above normal during the week ending the 19th. Rainfall was generally in excess early in the month but deficient later. (*The Times*, January 14th-19th, and *Washington, D.C., U.S. Dept. Agric. Weekly Weather and Crops Bulletin.*)

Rainfall, January, 1932—General Distribution

England and Wales	111	per cent of the average 1881-1915.
Scotland	150	
Ireland	122	
British Isles	123	

Rainfall : January, 1932 : England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Lond	Camden Square	1·60	86	*Leics*	Belvoir Castle	·96	54
Sur	Reigate, Alvington	3·10	129	*Rut*	Ridlington	1·11	60
Kent	Tenterden, Ashenden	3·13	145	*Linc*	Boston, Skirbeck	·96	59
,,	Folkestone, Boro. San.	1·59	...	,,	Cranwell Aerodrome	·70	41
,,	Margate, Cliftonville	·85	51	,,	Skegness, Marine Gdns	·95	55
,,	Sevenoaks, Speldhurst	2·13	...	,,	Louth, Westgate	1·58	73
Sus	Patching Farm	3·11	119	,,	Brigg, Wrawby St.	·95	...
,,	Brighton, Old Steyne	2·02	83	*Notts*	Worksop, Hodsock	1·04	59
,,	Heathfield, Barklye	4·19	155	*Derby*	Derby, L. M. & S. Rly.	1·69	84
Hants	Ventnor, Roy. Nat. Hos.	2·95	115	,,	Buxton, Devon Hos.	5·56	124
,,	Fordingbridge, Oaklnds	2·41	87	*Ches*	Runcorn, Weston Pt.	2·43	102
,,	Ovington Rectory	4·96	184	,,	Nantwich, Dorfold Hall	2·69	...
,,	Sherborne St. John	3·21	138	*Lancs*	Manchester, Whit. Pk.	3·39	135
Berks	Wellington College	1·98	100	,,	Stonyhurst College	5·61	131
,,	Newbury, Greenham	3·28	142	,,	Southport, Hesketh Pk	3·81	149
Herts	Welwyn Garden City	1·91	...	,,	Lancaster, Strathspey	4·72	...
Bucks	H. Wycombe, Flackwell	1·60	...	*Yorks*	Wath-upon-Dearne	1·12	58
Oxf	Oxford, Mag. College	1·40	81	,,	Bradford, Lister Pk	2·60	90
Nor	Pitsford, Sedgebrook	1·87	101	,,	Oughtershaw Hall	11·40	...
,,	Oundle	·84	...	,,	Wetherby, Ribston H.	1·64	80
Beds	Woburn, Crawley Mill	1·44	84	,,	Hull, Pearson Park	1·38	77
Cam	Cambridge, Bot. Gdns.	·79	53	,,	Holme-on-Spalding	1·29	...
Essex	Chelmsford, CountyLab	1·15	75	,,	West Witton, Ivy Ho.	3·61	114
,,	Lexden Hill House	·64	...	,,	Felixkirk, Mt. St. John	1·61	80
Suff	Haughley House	·86	...	,,	Pickering, Hungate	1·70	81
,,	Campsea Ashe	·94	52	,,	Scarborough	1·02	51
Norf	Norwich, Eaton	·87	44	,,	Middlesbrough	1·16	72
,,	Wells, Holkham Hall	1·25	86	,,	Baldersdale, Hury Res.	4·47	...
,,	Swaffham, The Villa	1·06	56	*Durh*	Ushaw College	1·66	81
Wilts	Devizes, Highclere	2·61	120	*Nor*	Newcastle, Town Moor	·62	30
,,	Bishops Cannings	2·55	110	,,	Bellingham, Highgreen	2·71	95
Dor	Evershot, Melbury Ho.	5·05	145	,,	Lilburn Tower Gdns.	1·62	78
,,	Creech Grange	2·87	88	*Cumb*	Geltsdale	3·53	...
,,	Shaftesbury, AbbeyHo.	2·29	88	,,	Carlisle, Scaleby Hall	3·64	147
Devon	Plymouth, The Hoe	4·43	133	,,	Borrowdale, Seathwaite	22·74	175
,,	Launceston, Werringt'n	6·84	171	,,	Borrowdale, Moraine*	22·05	...
,,	Holne, Church Pk. Cott.	14·16	229	,,	Keswick, High Hill	11·94	...
,,	Cullompton	3·59	111	*West*	Appleby, Castle Bank	6·69	209
,,	Sidmouth, Sidmount	2·83	99	*Glam*	Cardiff, Ely P. Stn.	5·60	148
,,	Filleigh, Castle Hill	4·48	...	,,	Treherbert, Tynywaun	18·47	...
,,	Barnstaple. N. Dev. Ath	3·56	109	*Carm*	Carmarthen Friary	...	...
,,	Dartm'r, Cranmere Pool	15·00	...	*Pemb*	Haverfordwest, School	7·08	153
Corn	Redruth, Trewirgie	4·97	118	*Card*	Aberystwyth	4·52	...
,,	Penzance, Morrab Gdn.	4·75	125	,,	Cardigan, County Sch.	6·00	...
,,	St. Austell, Trevarna	4·89	114	*Brec*	Crickhowell, Talymaes	6·50	...
Soms	Chewton Mendip	4·46	116	*Rad*	BirmW.W.Tyrmynydd	9·17	154
,,	Long Ashton	4·53	158	*Mont*	Lake Vyrnwy	9·65	171
,,	Street, Millfield	1·97	81	*Denb*	Llangynhafal	3·09	117
Glos.	Blockley	2·77	...	*Mer*	Dolgelly, Bryntirion	8·13	143
,,	Cirencester, Gwynfa	3·72	148	*Carn*	Llandudno	3·38	131
Here	Ross, Birchlea	4·09	169	,,	Snowdon, L. Llydaw 9	28·20	...
,,	Ledbury, Underdown	2·80	127	*Ang*	Holyhead, Salt Island	4·83	166
Salop	Church Stretton	4·57	181	,,	Lligwy	6·90	241
,,	Shifnal, Hatton Grange	2·15	111	*Isle of Man*			
Worc	Ombersley, Holt Lock	2·33	121		Douglas, Boro' Cem.	4·02	120
War	Birminghm, Edgbaston	2·37	117	*Guernsey*			
Leics	Thornton Reservoir	1·26	64		St. PeterP't. GrangeRd.	2·48	85

* Previously called Borrowdale, Rosthwaite.

Rainfall : January, 1932 : Scotland and Ireland

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per cent. of Av.
Wigt .	Pt. William, Monreith	3·07	94	*Suth* .	Melvich	4·71	...
,, .	New Luce School	3·19	79	,, .	Loch More, Achfary	14·79	203
Kirk .	Carsphairn, Shiel	12·76	174	*Caith* .	Wick	3·41	138
Dumf.	Dumfries, Crichton, R.I	5·24	...	*Ork* .	Pomona, Deerness	4·51	131
,, .	Eskdalemuir Obs.	12·17	225	*Shet* .	Lerwick	5·46	128
Roxb .	Branxholm	5·82	212	*Cork* .	Caheragh Rectory	6·76	...
Selk .	Ettrick Manse	13·96	295	,, .	Dunmany Rectory	8·49	136
Peeb .	West Linton	6·23	...	,, .	Ballinacurra	4·76	120
Berk .	Marchmont House	2·13	95	,, .	Glanmire, Lota Lo.	5·47	127
Hadd .	North Berwick Res.	1·45	84	*Kerry*.	Valentia Obsy.	7·32	133
Midl .	Edinburgh, Roy. Obs.	2·99	172	,, .	Gearahameen	14·90	...
Lan .	Auchtyfardle	6·37	...	,, .	Killarney Asylum	9·24	156
Ayr .	Kilmarnock, Kay Pk.	6·95	...	,, .	Darrynane Abbey	6·40	128
,, .	Girvan, Pinmore	5·65	120	*Wat* .	Waterford, Gortmore	4·24	116
Renf .	Glasgow, Queen's Pk.	7·30	218	*Tip* .	Nenagh, Cas. Lough	5·15	130
,, .	Greenock, Prospect H.	10·42	153	,, .	Roscrea, Timoney Park	2·99	...
Bute .	Rothesay, Ardencraig.	10·07	223	,, .	Cashel, Ballinamona	3·83	101
,, .	Dougarie Lodge	5·57	...	*Lim* .	Foynes, Coolnanes	4·62	122
Arg .	Ardgour House	21·19	...	,, .	Castleconnel Rec.	4·69	...
,, .	Glen Etive	21·90	208	*Clare* .	Inagh, Mount Callan	7·00	...
,, .	Oban	9·55	175	,, .	Broadford, Hurdlest'n.	4·60	...
,, .	Poltalloch	9·11	180	*Wexf*.	Gorey, Courtown Ho.	3·75	120
,, .	Inveraray Castle	15·18	185	*Kilk* .	Kilkenny Castle	3·50	109
,, .	Islay, Eallabus	6·60	141	*Wic* .	Rathnew, Clonmannon	3·38	...
,, .	Mull, Benmore	11·60	...	*Carl* .	Hacketstown Rectory	3·21	90
,, .	Tiree	5·65	...	*Leix* .	Blandsfort House	4·49	137
Kinr .	Loch Leven Sluice	3·09	98	,, .	Mountmellick	4·67	...
Perth .	Loch Dhu	13·75	151	*Off'ly* .	Birr Castle	3·94	139
,, .	Balquhidder, Stronvar	14·98	...	*Kild'r*.	Monasterevin	3·19	...
,, .	Crieff, Strathearn Hyd.	5·86	146	*Dubl* .	Dublin, FitzWm. Sq.	2·15	94
,, .	Blair Castle Gardens	4·43	133	,, .	Balbriggan, Ardgillan.	2·07	90
Angus.	Kettins School	3·05	129	*Me'th* .	Beauparc, St. Cloud	2·93	...
,, .	Dundee, E. Necropolis	1·81	93	,, .	Kells, Headfort	3·47	110
,, .	Pearsie House	3·49	..	*W.M* .	Moate, Coolatore	3·08	...
,, .	Montrose, Sunnyside	1·32	66	,, .	Mullingar, Belvedere	4·27	133
Aber .	Braemar, Bank	5·30	166	*Long* .	Castle Forbes Gdns.	4·47	134
,, .	Logie Coldstone Sch.	2·24	93	*Gal* .	Ballynahinch Castle	6·88	111
,, .	Aberdeen, King's Coll.	1·83	84	,, .	Galway, Grammar Sch.	4·56	...
,, .	Fyvie Castle	2·59	109	*Mayo* .	Mallaranny	8·78	...
Moray.	Gordon Castle	1·66	82	,, .	Westport House	7·77	167
,, .	Grantown-on-Spey	2·24	93	,, .	Delphi Lodge	13·06	128
Nairn.	Nairn, Delnies	2·76	139	*Sligo* .	Markree Obsy	5·48	139
Invs .	Ben Alder Lodge	12·82	...	*Cav'n* .	Belturbet, Cloverhill	...	...
,, .	Kingussie, The Birches	5·92	..	*Ferm* .	Enniskillen, Portora	4·37	...
,, .	Loch Quoich, Loan	31·75	...	*Arm* .	Armagh Obsy	3·06	121
,, .	Glenquoich	21·63	157	*Down* .	Fofanny Reservoir	6·61	...
,, .	Inverness, Culduthel R.	4·29	..	,, .	Seaforde	2·95	94
,, .	Arisaig, Faire-na-Squir	7·60	...	,, .	Donaghadee, C. Stn.	2·72	107
,, .	Fort William	17·12	...	,, .	Banbridge, Milltown	1·96	...
,, .	Skye, Dunvegan	11·36	...	*Antr* .	Belfast, Cavehill Rd.	2·85	...
R & C.	Alness, Ardross Cas.	5·56	146	,, .	Glenarm Castle	5·87	...
,, .	Ullapool	9·09	199	,, .	Ballymena, Harryville	4·32	117
,, .	Torridon, Bendamph.	...	...	*Lon* .	Londonderry, Creggan	5·06	141
,, .	Achnashellach	16·97	...	*Tyr* .	Omagh, Edenfel	5·02	142
6·45 ,, .	Stornoway	~~6·52~~	...	*D.n* .	Malin Head	4·04	...
Suth .	Lairg	5·08	155	,, .	Dunfanaghy	5·08	...
,, .	Tongue	5·91	150	,, .	Killybegs, Rockmount	4·64	83

Climatological Table for the British Empire, August, 1931

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1012·4	— 2·9	77	44	66·7	53·8	60·3	— 1·3	54·6	85	7·8	4·85	+ 2·61	16	4·4	30
Gibraltar	1015·3	— 1·4	93	61	84·0	66·1	75·1	— 0·9	64·4	79	2·4	0·00	— 0·13	0	..	..
Malta	1014·3	— 0·5	104	67	87·9	73·7	80·8	+ 1·7	72·4	71	1·5	0·00	— 0·14	0	11.8	88
St. Helena	1018·7	+ 1·9	68	53	58·8	54·4	56·6	— 0·8	54·8	97	9·8	3·82	..	21	..	..
Sierra Leone	1015·1	+ 2·4	86	66	81·2	69·5	75·3	— 2·6	75·4	91	9·0	33·67	— 2·90	30	..	..
Lagos, Nigeria	1014·0	+ 0·4	86	71	83·0	75·1	79·1	+ 1·4	74·8	84	9·3	2·10	— 0·70	16	..	..
Kaduna, Nigeria	1014·5	— 0·6	96	..	88·6	..	..	..	71·9	86	8·8	4·86	— 4·82	21	..	..
Zomba, Nyasaland	1016·1	— 0·7	85	49	77·5	55·7	66·6	+ 1·7	..	60	3·2	0·00	— 0·37	0	..	..
Salisbury, Rhodesia	1016·1	— 0·2	87	41	77·3	47·9	62·6	+ 2·4	50·1	39	0·0	0·00	— 0·06	0	10·4	90
Cape Town	1020·6	+ 0·3	84	41	64·1	48·8	56·5	+ 0·9	50·1	87	6·0	3·97	+ 0·60	18	..	..
Johannesburg	1019·1	+ 0·2	77	34	68·0	46·1	57·1	+ 2·7	42·2	32	0·6	0·00	— 0·51	0	10·5	94
Mauritius	1020·9	+ 0·4	79	57	75·4	63·0	69·2	+ 0·7	65·3	72	4·8	1·20	— 1·15	18	8·3	73
Calcutta, Alipore Obsy.	997·8	— 3·2	94	77	89·9	80·3	85·1	+ 1·9	80·8	92	8·2	8·77	— 4·61	19*	..	..
Bombay	1002·8	— 3·1	88	75	85·3	76·8	81·1	+ 0·3	77·3	88	9·1	23·71	+ 9·26	25*	..	..
Madras	1003·8	— 1·7	99	75	95·0	78·5	86·7	+ 0·7	76·5	70	6·9	3·91	— 0·63	10*	..	..
Colombo, Ceylon	1009·9	+ 0·6	86	72	84·3	76·2	80·3	— 0·9	77·2	82	8·2	9·11	+ 5·87	25	5·7	46
Singapore	1008·6	— 0·9	93	71	89·7	77·6	83·7	+ 2·1	78·4	81	7·7	5·74	— 2·21	9	7·5	61
Hongkong	1000·9	— 4·1	94	75	87·3	79·2	83·3	+ 1·2	78·9	80	7·5	14·27	— 0·37	18	6·7	52
Sandakan	..	..	93	73	90·2	75·3	82·7	+ 0·9	77·7	82	..	13·29	+ 5·40	10	..	..
Sydney, N.S.W.	1017·0	— 1·2	80	41	66·1	47·7	56·9	+ 1·9	49·6	68	3·2	0·32	— 2·65	6	7·8	72
Melbourne	1016·2	— 1·8	64	36	57·6	44·1	50·9	— 0·1	47·2	80	7·6	1·87	0·00	19	4·0	37
Adelaide	1017·9	— 1·4	67	42	60·6	46·4	53·5	— 0·4	48·9	72	5·9	2·55	+ 0·02	20	5·0	46
Perth, W. Australia	1017·7	— 1·2	71	38	63·7	48·3	56·0	0·0	51·2	70	6·8	6·84	+ 1·19	19	4·9	45
Coolgardie	1019·1	— 0·2	76	34	63·9	43·0	53·5	— 0·1	47·5	63	3·2	1·57	+ 0·58	7	..	..
Brisbane	1019·0	— 0·2	79	43	72·2	51·3	61·7	+ 1·3	54·9	69	4·7	0·90	— 1·18	7	7·5	67
Hobart, Tasmania	1009·2	— 4·2	63	34	54·3	41·6	47·9	— 0·1	43·1	69	6·6	1·19	— 0·64	19	5·0	48
Wellington, N.Z.	1012·9	— 2·2	57	32	51·0	41·4	46·2	— 2·4	44·5	81	7·4	2·23	— 2·26	18	4·3	41
Suva, Fiji	1013·6	— 0·6	88	62	79·0	69·8	74·4	+ 0·8	69·7	77	6·5	6·16	— 2·13	14	4·3	37
Apia, Samoa	1011·2	— 1·1	87	69	84·3	74·0	79·1	+ 1·3	75·8	77	5·7	2·00	— 1·63	10	7·1	61
Kingston, Jamaica	1013·7	+ 0·2	94	73	90·3	74·6	82·5	+ 1·0	73·1	80	3·3	1·83	— 1·72	5	7·8	61
Grenada, W.I.	1013·5	+ 0·9	90	73	88·3	74·8	81·5	+ 1·8	75·2	77	4·7	9·17	— 0·16	26	..	..
Toronto	1016·3	+ 0·9	92	46	78·4	60·5	69·5	+ 2·3	61·8	72	4·2	2·10	— 0·69	11	7·9	56
Winnipeg	1014·4	+ 1·2	100	36	78·2	55·5	66·9	+ 3·1	55·3	68	4·3	2·02	— 0·14	8	8·7	60
St. John, N.B.	1015·9	+ 0·6	79	49	72·1	55·6	63·9	— 3·3	59·8	83	5·4	4·04	+ 0·18	13	7·7	55
Victoria, B.C.	1018·6	+ 1·7	84	50	68·0	52·1	60·1	+ 0·4	55·8	83	2·7	0·20	— 0·44	4	11·3	79

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The Abnormally High Pressure of February, 1932

The last week of January was marked by extraordinarily high barometer readings over the British Isles,* and high readings have continued almost without intermission throughout the whole of February. The month opened with an anticyclone centred over Ireland, where the readings exceeded 1044 mb. on the 1st. This persisted until the 4th, decreasing gradually in intensity; on the 5th it moved to Scandinavia, and on the 6th and 7th the centre lay over central Europe. On the 8th, however, a very sudden change occurred; the anticyclone moved rapidly north-eastward, while a depression between Ireland and Spitzbergen moved over Europe. Between the 9th and the 14th a very intense anticyclone moved slowly from Scandinavia to a position west of Ireland, whence it again passed over the British Isles, giving pressures above 1040 mb. every day until the 22nd. On the 18th and 19th the British centre formed part of a long ridge extending eastwards across Europe, giving easterly winds and very cold weather, but on the 20th this connexion was broken, and with northerly winds the temperature rose somewhat. During the remainder of the month the British anticyclone moved slowly northward to a position between Iceland and southern Scandinavia; on the 28th it again united with a ridge

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*See *Meteorological Magazine*, February, 1932, p. 18.

(97731) 107/27 1,125 3/32 M. & S. *Gp.303*

of high pressure extending into Russia, and there followed a period of strong easterly winds, dry and bitterly cold.

Taking the month as a whole, the centre of the anticyclone lay over northern Ireland, the average pressure at Malin Head being as high as 1035·4 mb., or 25·7 mb. above normal. So well developed an anticyclone would be noteworthy if it persisted for only a few days; as the average distribution for a month it is unique. At Stornoway the mean pressure was slightly lower, 1034·8 mb., but this was 27·0 mb. above normal, probably the greatest deviation of pressure from normal in this region since the beginning of the *Daily Weather Report.* At Thorshavn the mean for the month was 1031·7 mb., while during the famous cold month of February, 1895 (the previous highest February mean on record there), the figure was only 1025·8 mb. The fortunate result that the temperature in February, 1932, was much higher than that in 1895 (at Kew the mean this year was 38·4° F. compared with 29·1° F. in 1895) was due to the circumstance, noted above, that the anticyclone was mainly an

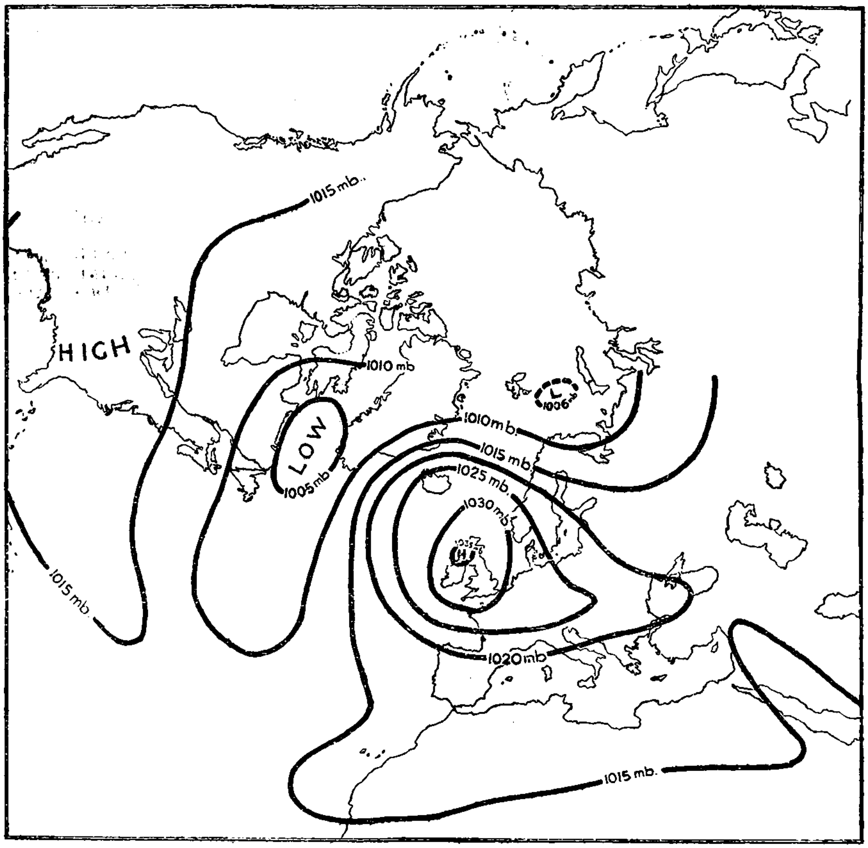

Fig. 1.

isolated phenomenon lying over the sea, and was only connected with the great winter reservoir of cold air in north-eastern Europe for two short periods.

The average distribution of pressure during the past month is shown in fig. 1, and the deviations from normal in fig. 2. The most striking point about fig. 1 is the complete reversal of the normal pressure gradient from the Azores to Scotland, giving easterly winds over a large area. The centre of the Icelandic depression was displaced far to the south-west, and lay near Newfoundland, while a long trough of low pressure extended across the Atlantic towards the Azores. An interesting point in fig. 2 is the limitation of the area occupied by pressures above normal, which is completely surrounded by an area of deficit accentuated at three almost equi-distant points. It is probable that in spite of the intensity of the anticyclone, the compensation by the surrounding pressure deficits was practically complete within the relatively small part of the northern hemisphere shown in fig. 2.

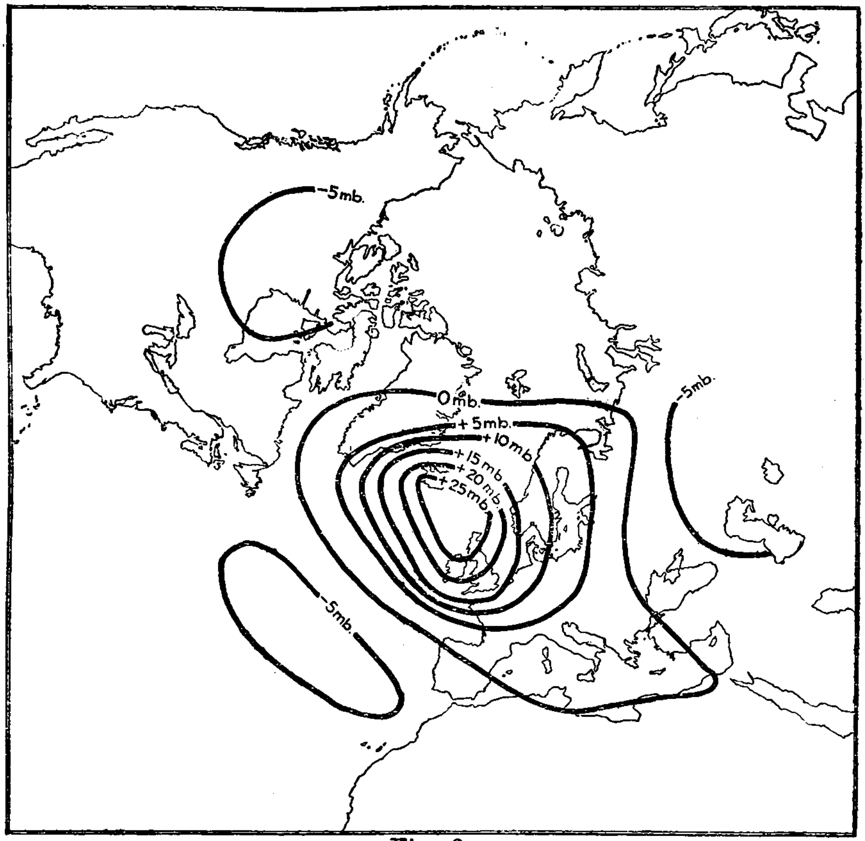

Fig. 2.

The Drought in Scotland during January and February, 1932

By J. CRICHTON, M.A., B.Sc.

During the last half of January, throughout February and in the first week of March over the greater part of Scotland there

TABLE I

Period, January—February, 1932

County	Greatest period in days of		Rainfall reported in County		No. of stations in County used
	*Absolute drought	*Partial dought	Lowest	Highest	
			in.	in.	
Wigtown	35	44	·01	·07	5
Kirkcudbright	36	40	·00	·41	8
Dumfries	15	39	·06	·13	6
Roxburgh	17	44	·21	·36	4
Selkirk	—	36	·35	·35	1
Peebles	—	36	·32	·32	1
Berwick	22	44	·37	·67	3
Haddington	17	41	·24	·33	2
Midlothian	—	40	·18	·59	7
Linlithgow	—	40	·15	·15	1
Lanark	29	41	·00	·21	4
Ayr	27	41	·00	·14	9
Renfrew	29	41	·00	·03	3
Dumbarton	25	39	·03	·11	2
Stirling	22	45	·03	·07	7
Bute	18	41	·05	·22	2
Argyll	24	39	·03	·41	10
Clackmannan	19	41	·04	·04	1
Kinross	—	41	·06	·06	1
Fife	19	41	·07	·27	5
Perth	32	41	·00	·24	17
Angus	17	41	·10	·20	4
Kincardine	—	41	·14	·14	1
Aberdeen	—	41	·18	·98	8
Banff	—	—	·24	1·02	4
Moray	—	—	·56	·61	2
Nairn	—	—	·44	·57	2
Inverness	—	41	·14	1·43	14
Ross and Cromarty	—	36	·22	1·05	5
Sutherland	—	—	·43	2·67	4
Caithness	—	—	·54	1·04	3
Orkneys and Shetlands	—	—	·66	1·15	4

TOTAL ... 150

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* In accordance with the Meteorological Office definitions an absolute drought has been taken as a period of at least 15 consecutive days, to none of which is credited ·01 inch of rain or more, and a partial drought as a period of at least 29 consecutive days, the mean daily rainfall of which does not exceed ·01 inch. (See *Meteorological Glossary*, p. 62.)

was a large deficiency of rainfall, the defect being very pronounced in all except extreme northern and north-eastern districts. A preliminary examination of the rain returns reveals that absolute and partial droughts were experienced in most counties. In Table I an analysis of such returns is given covering the two months January and February. The numbers in columns (1), (2), (3), and (4) of this table do not refer to one station but to the total number of stations given in column (5). In addition to the 150 stations given there may be added 23 stations of the Glasgow Waterworks, situated mostly in Perthshire, all of which had 0·20in. or less during the month of February. The dry spell continued into March, but no actual data for March are available.

TABLE II

Contrasting totals for several stations

County	*Station*	*January* in.	*February* in.
Wigtown	Monreith	3·07	·01
Kirkcudbright	Garroch	12·07	·07
,,	Forrest Lodge	14·00	·16
,,	Chipperkyle	6·44	·00
Dumfries	Monaive (Glencrosh)	9·37	·07
Selkirk	Ettrick Manse	13·96	·35
Lanark	Hamilton	7·17	·00
Ayr	Maybole (Otterden)	6·15	·00
,,	Ayr	5·09	·00
,,	New Cumnock	10·11	·04
Renfrew	Greenock	10·42	·00
Dumbarton	Arrochar	18·82	·14
Stirling	Lennoxtown	7·73	·03
Argyll	Pollock House	19·47	·58
,,	Ardgour	21·19	·41
,,	Glen Etive	21·90	·00
,,	Glencroe	19·95	·09
Perth	Stronvar	14·98	·00
,,	Tyndrum Manse	20·57	·11
,,	Corriehichon	18·30	·00
Inverness	Loan	31·75	·60
,,	Kinlochquoich	29·49	·55
,,	Glenquoich	21·63	·54
,,	Fort William	17·12	·14

Note.—An inch of rain is approximately equal to 100 tons of water per acre.

In Table II contrasts between totals for January and February are very interesting, particularly when it is borne in mind that most of the January rainfall fell during the first three weeks of that month.

In February many places had no rainfall while at others, where there was measurable rainfall, it was the driest month on record not only for February but for any month of the year. According to a report in the *Scotsman* on March 3rd, owing to the drought " Loch Lomond at Balmaha is now only 13 inches above its lowest point on record, the actual fall since January 16th being 6 feet 10 inches. On that date Loch Lomond, owing to the incessant rainfall, had attained a height of within 9 inches of its highest record ever recorded. The fall of 6 ft. 10 in. in the loch in such a short space of time is quite unprecedented, so far as Loch Lomond is concerned.''

Throughout Scotland rivers which are generally in winter flood were lower than they are frequently in midsummer and, as a result, salmon fishing was a failure. Owing to the dryness of the countryside great care was necessary to prevent accidental heath and gorse fires. The lack of snow was prejudicial to the much desired winter sports in Scotland, snow on even the highest slopes of the Grampians being rather scarce. A great advantage of the continued dry weather, however, was that all outdoor farm work became far advanced for the season.

During February anticyclonic conditions prevailed with quiet weather, the mean barometric pressure in the Edinburgh area being the highest for any month since at least 1769.

Wind and Tide

By H. St. G. Dyke-Marsh, B.A.

An article under the above title appeared in the *Meteorological Magazine* for October, 1925, in which were given the mean wind speeds at Holyhead at times of high and low water for each month from October, 1923, to September, 1924. There proved to be no difference, taking the whole year, between the mean speeds at high and low water, which also agreed with the mean speed at all hours; no account of wind direction was taken. An investigation on similar lines was subsequently undertaken by Mr. Baxendell, of the Fernley Observatory, Southport, using the records of the Marshside anemometer, situated at the Ribble estuary. The results in this case were also negative and the two investigations clearly indicated that the height of the tide, *i.e.*, the rise and fall of the water level, has no effect on wind speed, but did nothing to suggest whether the wind speed in the lowest layers was appreciably affected by reduced or increased friction between air and water in the case of tidal streams flowing approximately with or against the wind.

This aspect of the question was first investigated statistically by Mr. Baxendell in 1926, who published the results in the *Annual Report of the Fernley Observatory for* 1925.

The winter months only were used, as it was considered sea and land breezes would mask the effect in summer, and only cases where a wind from the sea prevailed during at least seven hours centring on high water or low water were considered. The mean speeds of such " sea " winds from five hours before high water (H.W.) to five hours after it and for similar periods before and after low water (L.W.) were obtained from the records of the Marshside anemometer and showed the effect of the tidal stream very clearly in the following tables taken from the *Annual Report of the Fernley Observatory, Southport, for* 1925 :—

	Hours before H. W.					*H. W.*	*Hours after H. W.*				
	5	4	3	2	1		1	2	3	4	5
Mean Speed	23.0	23.5	24.1	24.1	23.8	23.1	22.5	22.0	21.8	21.1	21.6
	23.7						21.8				

	Hours before L. W.					*L. W.*	*Hours before L. W.*				
	5	4	3	2	1		1	2	3	4	5
Mean Speed	21.6	21.8	21.9	22.6	23.0	23.7	24.1	24.8	24.8	23.9	23.4
	22.2						24.2				

This gives a mean difference in wind speed of 2 m.p.h. according to whether tidal stream is flowing with or against the wind, with a maximum difference of 3 m.p.h. between the hours of maximum flood and ebb streams. The anemometer vane is 77 feet above mean sea level.

Recently an effort has been made in the Naval Division of the Meteorological Office to confirm the Southport results definitely by using existing records from anemometers situated so that coastal effects would not interfere. In this respect the Bell Rock anemograms were by far the most suitable, but unfortunately the tidal stream past the Bell Rock is never strong, not usually exceeding 1 knot. An analysis of the records for 1930 was, however, made and showed a very small positive effect, but it was insufficient to prove anything. The stream runs south with the flood and north with the ebb. The method used was to take the hours when the stream was running strongest, dividing the winds into those flowing with, against and perpendicular to the stream, the last including all winds between NE. and SE. and between SW. and NW. The mean speed of southerly winds flowing with the stream was compared with that of southerly winds flowing against it and similarly for northerly winds. The mean for the year only showed mean speed of winds with the stream as 0·3 m.p.h. greater than that of winds against the stream. The anemometer vane is, however, 130 feet above mean sea level and the tidal effect probably decreases rapidly with height.

Lastly, an analysis was made of the winds entered in the logs of the East Goodwin Lightship for 1928 and 1929 kept at Trinity House. This ship was selected as the tidal streams past it were stronger than those past any other lightship. The entries were wind direction and estimated force on the Beaufort scale at three-hour intervals throughout the day, the state of the tide whether flood, ebb, high water or low water being indicated. The observations did not usually coincide with the times of strongest tidal streams, but all observations except those at slack water were considered, most flood and ebb periods having two observations at varying phases of the flood or ebb. The directions of the tidal streams being given by Admiralty charts as 209° during flood and 29° during ebb, only winds from N. to ENE. and from S. to WSW. were included, *i.e.*, about 40° on each side of the stream direction. The mean force of all winds from N. to ENE. when flowing with the stream was compared with the mean force of winds from the same directions flowing against the stream, and similarly for S. to WSW winds, for each month of the two years and with three small exceptions gave consistently positive results. The results over the two years were as follows:—

Mean force of N.-ENE. winds, with stream, 3·8; against stream, 3·4
,, ,, S.-WSW. ,, ,, , 4·3; ,, ,, , 3·9
Mean difference in force, 0·4, probably equivalent to about $2\frac{1}{2}$ m.p.h. or two knots.

The mean speed of tidal streams over the whole period of flood and ebb, neap and springs being about 2 knots, the wind speed is therefore increased by about half the speed of the stream when flowing with the tide and similarly decreased when flowing against the stream.

Conclusion.—All the work done on this question has gone to indicate that changes in level of the sea have no appreciable effect on wind, but that horizontal currents or tidal streams have an effect by decreasing or increasing friction which is quite perceptible in favourable circumstances. It is probable, however, that the effect is limited to a surface layer of air of little depth.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, February 17th, at 49, Cromwell Road, South Kensington, Prof. S. Chapman, F.R.S., President, in the Chair.

W. H. Pick, B.Sc., F.Inst.P.—Visibility at Sea.

The main results obtained from the investigation may be summarised as under:—(*a*) The open ocean in the eastern North Atlantic is a region of singularly good visibility, both in summer and in winter. (*b*) Both in summer and in winter the highest percentages of good visibilities occur with the air temperature less than the sea temperature; but the fact that high percentages of good visibilities are also obtained with air that is warmer than the sea beneath is noteworthy. (*c*) With regard to wind force, the lowest percentages of good visibilities occur with the strongest winds. (*d*) The large majority of fogs occur with air temperature either greater than, or equal to, the sea temperature, but there is an appreciable residue that occur when the air temperature is lower than the sea temperature. (*e*) G. I. Taylor's observation that nearly all fogs occurring with air temperature lower than the sea temperature are accompanied by "very light" winds is supported so far as "summer" is concerned, but is not supported quite so well for "winter." (*f*) Just under half of all the fogs occurring do so with a wind force of 4 or more.

M. G. Bennett, M.Sc.—The visual range of lights at night and its relation to the visual range of ordinary objects by day.

The visual range of a point source of light is given by the relation that the product of the intensity of the source and the transmission coefficient of the air, divided by the square of the distance, is a constant. The author described experiments in which this constant is shown to depend on the brightness of the background, roughly according to the empirical formula:—

$$\text{constant} = 0{\cdot}12\ 10^{-4}\ B^{\frac{2}{3}}$$

where B is the brightness of the background in apparent candle power per sq. Km. (To illustrate this unit it may be remarked that a perfectly diffusing and reflecting screen illuminated by a light of one candle power at a distance of one kilometre would have a value of B equal to unity.) From these results, and their application to some observations quoted by Bigg, deductions are made as to the magnitude of the effect of background on the visual range of lights, and on the relation between the visual range of lights at night and of ordinary objects by day.

S. E. Ashmore, B.Sc.—The occurrence of fog with unsaturated air at Grayshott, Hants.

The meteorological records at Grayshott have been utilised in investigating the frequency of occurrence of fog with unsaturated air, separate consideration being given to occasions with solid or liquid precipitation or with air temperature below freezing-point. The relation of such fogs to accompanying meteorological factors, such as wind and cloud, has been analysed. Finally, an analysis of occasions of good visibility with differing humidity ranges has been made. The results have been compared with those for a few other stations. The results appear in some degree to contradict the smoke theory of unsaturated fogs.

Correspondence

To the Editor, *The Meteorological Magazine.*

Diffusion on a Cold Front

In the course of a discussion on February 15th of Palmén's paper on a cold "break through," I suggested that the cause of the lower temperature at a distance of 100 kilometres or more in advance of the cold front of April 20th, 1929, might be due to the " diffusion " of the cold air by turbulence. I had in mind the comparatively large scale turbulence which is produced at the cold front itself, where masses of cold air will be continually breaking away from the main mass.

If the view of the cold front, as protruding over the warm air until the instability is so marked that a small catastrophe occurs, and the overhanging portion of the cold air breaks through, is correct, the turbulent masses of cold air will be large. If Giblett's view of a more or less permanent overhanging cold front, continuously renewed, is correct, the masses of cold air will be smaller. But on either view they will not be the small turbulence of an ordinary wind. As Giblett remarked: " I have observed there (*i.e.*, at the front) a most amazing state of turbulence." It is therefore reasonable to assume a large value for K, the eddy conductivity (or diffusivity). Values of K up to 7×10^8 were found by Richardson from the scatter of small free balloons, *i.e.*, the turbulence of an ordinary wind over undulating country: thus a value of 10^9 would not be excessive for the turbulence originating at a cold front. With this value of K, the order of magnitude of the time required for the turbulence to carry cold air (in appreciable quantity) 100 kilometres in advance of the front is (in seconds):—

$$5 \times 10^4 \text{ or about 14 hours,}$$

using the formula $\sigma^2 = 2Kt$, and assuming that the forward velocity of the cold front is approximately equal to the component velocity of the warm air (not just at the surface but at an altitude of 1,000 feet or more) at right angles to the front. This is of the right order of magnitude and indicates that the pre-frontal cooling may be merely another phenomenon of turbulence, and that the extent of its advance ahead of the front will be mainly a function of the age of the front.

E. GOLD.

February 16th, 1932.

A Snowless Winter

Last autumn the press made laudable efforts to encourage winter sports in Scotland. There was " every sign of a hard winter "; so said the writers. But the weather took exception to these remarks. Owing to the intense anticyclonic conditions since mid-January and the exceptional mildness preceding them, Scotland seems to have had the most snowless winter on record, Mr. Seton Gordon, writing from Skye on February 9th, said that there was no snow at all on the Cuillins or the higher Ross-shire hills of 3,500ft. Such a state of things must be unprecedented in living memory. At the end of February Ben

Nevis had only a slight coating on its upper 500ft. instead of a normal depth of 6ft. extending down to 1,000ft. or so above sea level. The Fort William rainfall in February was only 0·14in., which must be a record for any month at that wet station. All the Scottish salmon rivers are at low summer level and prospects hopeless at the time of writing, since there are no vast accumulations of snow on the hills to keep up their level through the early summer as is invariably the case. The February rainfall here was 0·16in., driest in 26 years' observations at this station and for the 44 days since January 16th (when the wet spell ended) 0·24in.

R. P. DANSEY.

Kentchurch Rectory, Hereford. March 1st, 1932.

The Persistent Drought

Since January 16th no measurable quantity of rain has been collected in my gauge. Technically, therefore, the drought here, up to date, has been unbroken for forty-seven days, nor is there immediate indication of change.

Drizzle gave " traces " on January 21st and February 23rd. Further there were a few drops from fog deposit on three or four days early last month, which perhaps nearly totalled to 0·01in. About 6 a.m. on the 10th there was a brief squall of powdery snow, but the gauge gave only a few drops on melting. As it lay, however, ⅓in. deep, I have entered it as 0·02in.

This presumably divides the period into two " absolute droughts " of 24 and 22 days for recording purposes.

At York in February, 1891, no rain actually fell, but there was a smart shower at 6 a.m. March 1st.

J. EDMUND CLARK.

Portway Street, Somerset. March 3rd, 1932.

This drought, having lasted 51 days, ended soon after noon March 8th—0·29in. of rain was measured at 9 a.m. on the 9th. Presumably rain ceased about midnight as frost (32°F.) followed.

J. E. CLARK.

March 9th, 1932.

The Drought and High Pressure of February

February last has been the driest calendar month on record, and the mean barometric pressure the highest for any calendar month since 1848, when systematic observations were commenced at Stonyhurst Observatory.

The total rainfall in February was 0·13in., the previous driest February being in 1858 with a fall of 0·31in. The previous driest calendar month was May, 1859, with a fall of 0·25in.

The mean barometric pressure, reduced to mean sea-level, for

February this year was 30·538in. (1034·1mb.)—the previous record for any calendar month being 30·449in. (1031·1mb.) in February, 1891.

Further the mean barometric pressure, reduced to mean sea-level during the period January 17th to February 29th this year, a period of 44 days, when the British Isles were definitely under anticyclonic influence was 30·550in. (1034·5mb.), a higher mean than that for February. The highest reading recorded during this period was on January 26th, 31·035in. (1051·0mb.), at 11h. 30m. G.M.T. In the last 85 years this has only been exceeded once, namely, on 1896, January 26th, when the reading was 31·062in. (1051·9mb.).

E. D. O'CONNOR, S.J.

Stonyhurst College Observatory, Nr. Blackburn. March 6th, 1932.

Extreme Barometric Maxima in pairs

In Vol. 37 (1902) of this magazine, pp. 6 and 23, and in Vol. 40 (1905), p. 3, attention was drawn to an apparent tendency for instances of extremely high barometric pressure in the British Isles to occur in pairs separated by an interval of two to four weeks. The examples given were as follows :—

Year.	Date of first maximum.	Date of second maximum.	Interval in days.
1821	Jan. 23	Feb. 5	13
1825	Jan. 9	Jan. 28	19
1834-5	Dec. 15	Jan. 2	18
1882	Jan. 18	Feb. 1	14
1896	Jan. 9	Jan. 30	21
1902	Jan. 14	Jan. 31	17
1905	Jan. 1	Jan. 28	27

There is no precise statement of the criteria used in the formation of this list, but the pressure limit seems to have been set not lower than 1047mb. in respect of the dominant member of at least six out of the seven pairs. Most of what may be termed Britain's “ classical ” maxima) 1050mb. and above) are represented.

Another instance of such a recurrence has been furnished by the first two months of the present year. The exceptional barometric elevation of January 26th, when 1050mb. was slightly exceeded in the north of England (see the February issue of this magazine, p. 18), was followed 25 days later by a secondary maximum within 3mb. of that figure. In the *Daily Weather Report*, British section, of February 21st, 1047·4mb. is given as the reading for 13h. on February 20th at Inchkeith, Renfrew and Donaghadee.

Meteorology has made good headway since 1905, and not a few phenomena that could merely be recorded then have now been explained. It would be interesting to know whether any modern theory can account for an oscillation with a period of the order of two to four weeks in the intensity of a powerful and long-lived anticyclone established over or near our islands during winter, and also whether the tendency for extreme barometric maxima to be duplicated within a month has been observed in other parts of the world.

E. L. HAWKE.

"Caenwood," Rickmansworth, Herts. March 2nd, 1932.

Bands of Foam on the Dead Sea

The Dead Sea seen from the air during a gale on February 7th, 1932, presented a striking appearance. The height of the aircraft was about 4,000 feet, and at this height the wind was south-westerly 65-70 m.p.h. The wind in the deep depression near the Dead Sea was therefore probably S.-SSW., force 6-8. The surface of the sea was "moderate" on the sea disturbance scale, but the striking feature was the parallel bands of white foam which ran the whole length of the sea. These bands were orientated roughly south by west to north by east—i.e., slightly across the sea's major axis. The impression was that the lines of foam were interference bands due to two sets of waves or to one set of waves and their reflections from one shore.

As the sea was obscured at times by cloud and rain, it was not possible to count the number of bands accurately, but it is estimated that there were about 20 between the east and the west shore.

J. DURWARD.

Meteorological Office, Heliopolis. February 17th, 1932.

[The Dead Sea has a length of 47 miles and is 9½ miles across at its widest part, so that the bands of foam referred to would be somewhat less than a half-mile apart. According to the *Encyclopædia Britannica* a line of white foam extends along the axis of the lake almost every morning. This was supposed by Blanckenhorn to mark the line of a fissure under the bed of the lake (which lies along the line of a great geological fault), but has also been explained as a consequence of the current of the Jordan.—ED. *M.M.*]

NOTES AND QUERIES

Retirement of Father Louis Froc, S.J.

At the end of August, 1931, Father Louis Froc retired from the post of Director of Zi-ka-wei Observatory, Shanghai, which he had held since 1896. During that period he organised and maintained the system of daily weather reports and typhoon warnings issued by the Observatory, to the great benefit of the world's shipping, and was untiring in his study of the storms of the China Seas. Among his monographs on this subject may be mentioned the " Iltis " typhoon of July 22nd-25th, 1896, the " De Witte " typhoon of August 1st-6th, 1901, the " Chinhai " typhoon of July 28th, 1915, and the typhoon of August 8th-23rd, 1924, which followed an extraordinary looped track. As early as 1896 he issued the first part of a study of " Typhoon Highways in the Far East," and in 1920 he completed this work with an atlas giving the tracks of 620 typhoons between 1893 and 1918, which was recently brought up to date in a new edition. Father Froc also supervised a number of studies of the climatology of China, and in 1912 he prepared a work on " La pluie en Chine," which included eleven years' data for a region the greater part of which had previously been meteorologically almost unknown.

Father Froc's departure from Shanghai was the occasion of a series of receptions and presentations in his honour by the local authorities and the various Marine Societies.

Abstracts of Meteorological Literature

In scientific research, one of the essentials is a knowledge of what has already been done in any particular subject, but with the rapidly increasing output of scientific literature, such knowledge is becoming more and more difficult to attain. The first step is obviously to get references to the literature of one's subject, and for a number of years that need was met by the *International Catalogue of Scientific Literature*, commenced under the auspices of the Royal Society in 1901. This enterprise ceased in 1916, but the meteorological part has been continued in the Royal Meteorological Society's *Bibliography*, in which the same subject classification is employed. A file of the latter publication, rearranged under narrower sub-divisions and pasted on sheets, is kept in the Meteorological Office Library, where it is frequently consulted.

A bibliography alone is not enough, however, for it may show dozens of papers on the subject required; science, like art, is long, but life is short. To assist the quest, a commencement has been made in the formation of a complementary collection of "Abstracts," similarly classified under subjects, each abstract giving a brief summary of the main arguments or conclusions of a single paper. The sources from which the collection is being made are various; in the first place author's own summaries are being copied or translated where they are available, and publications such as *Science Abstracts* are being ransacked. For the literature of past years, the series of " Meteorological Office Abstracts " compiled by members of the staff forms an invaluable basis. In one way and another a collection of about a thousand abstracts and summaries has already been formed, but this covers a period of nearly ten years and is still only the merest skeleton. If the plan is to attain its ideal development, every important paper published in future must be represented, and where a summary is not given by the author, one must be made. This is an ambitious project, but a number of meteorologists have volunteered their assistance and the prospects appear to be hopeful. The collection of abstracts will be kept in the Library, and should ultimately become a tool of real value in meteorological research.

Exhibition by the Royal Meteorological Society in Edinburgh

In view of the interest aroused by the exhibition held in the Science Museum, London, during January and February, a similar exhibition is being arranged by the Royal Meteorological Society in the Royal Scottish Museum, Edinburgh, by permission of the Director, Mr. E. Ward. The exhibition will be opened during the first week in April and will remain open for about three months.

Wet week-ends in 1931

Mr. James Cleland reports the following rainfall amounts on the various days of the week during 1931 at Gorway, near Walsall, in Staffordshire :—

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
6·37	1·68	3·15	3·04	5·32	5·26	6·71

Total 31·53 in. on 156 days.

The " day " covers the 24 hours beginning at 9 a.m.

These statistics are of interest in comparison with similar values for Lympne Air Port given by Mr. H. E. Carter.* They are also of interest in comparison with those given by Dr. J. R. Ashworth, in a paper in which he argued that the large quantities of coal consumed in manufacturing towns produced an upward current of hot air sufficient to influence the rainfall. For a period of 30 years at Stonyhurst he found that the average rainfall on week-days was 6 per cent. more than the average on Sundays.†

* *Meteorological Magazine* 66, 1931, p. 163.

† *Ibid.* 64, 1929, p. 109.

Reviews

Veröffentlichungen des Forschungs—Institutes der Rhön-Rossitten-Gesellschaft e.V. Nr. 4. Jahrbuch, 1929. Edited by Dr. W. Georgii. Munich and Berlin, 1931.

This volume maintains the high standard of previous year-books, and should be studied by all interested in gliding flight and associated problems. The first part of the book is devoted to the work of the Research Institute during the year, and on the meteorological side this consists mainly of measurements of upward currents, which now include observations from aeroplanes. The vertical motion of the atmosphere is a complicated process, thermal and dynamical factors being simultaneously involved. K. O. Lange contributes a long paper on the use of balanced pilot balloons. In the earlier part of the paper various sources of error, such as temperature changes, insolation and leakage are discussed, probably more thoroughly than ever before. The results of the actual investigation of the air motion are set out with the aid of numerous diagrams. Once the air stream breaks into eddies, the effect of a hill extends far to leeward, to a distance very large in comparison with the height of the hill.

Some aerological data are also published. In this connexion it may be mentioned that meteorological flights are being made from five German aerodromes, the observations being published in the *Aerologische Berichte* (Berlin). This mass of data should prove useful to anyone investigating upper air temperatures, though of course the area where observations are available, from England to Germany, is much too small.

C. K. M. Douglas.

The wind at Agra and its structure. By Barket Ali, M.Sc. Memoirs of the Indian Meteorological Department, Vol. XXV, Part VI.

The author discusses the prevailing surface winds, diurnal variation, wind structure with reference to gustiness, squalls, eddy viscosity and eddy energy, and the correlation of surface with upper winds in India. The results of G. I. Taylor, W. Schmidt and L. F. Richardson are applied to the diurnal variation with satisfactory results. Some discrepancies are attributed to a plateau-plain effect. The correlation of surface winds with winds up to 1 Km. is found to be less than that at St. Omer, which is used for comparison. Considerable detail is given, and the paper should be consulted.

India Meteorological Department, Scientific Notes, Vol. III, No. 18, *The structure of the Madras storm of January,* 1929, by K. R. Ramanathan, M.A., D.Sc., and A. A. Narayana Iyer, B.A., and *No.* 19, *Distribution of air density at M.S.L. over India*, by U. N. Ghosh, M.Sc.

In view of the doubt which has frequently been expressed regarding the existence of fronts in depressions near the equator, the first of these two notes is of much interest. The records quoted show a zone of rapid change of wind direction and speed, temperature and vapour pressure at the trough of the depression discussed. The changes at the surface are of the type associated with diffuse warm fronts or occlusions. The work marks a definite forward step in the structural analysis of such depressions, and it is to be hoped that more complete examinations on these lines will become possible later on.

The second paper gives charts of the monthly and annual mean distribution of air density over India. The isopycnics are found to be in general similar to the isotherms of the corresponding periods. The changes from season to season are also shown diagrammatically.

Aerology. A ground school manual in aeronautical meteorology. By C. J. Maguire, S.M. Size 9 × 6in., pp. xii + 136, *Illus.* London, McGraw-Hill Publishing Co. Ltd.

This admirable book fulfils a want which has been long felt by "all-weather" aviators. It has a threefold aim: (1) to give the students of aeronautics an adequate knowledge of the medium through which all air traffic must navigate; (2) to show the principles upon which a weather service is based; and (3) to enable the airman to interpret, in the light of weather phenomena around him, the various advices available to him.

The ground covered is roughly that embraced in the syllabus for a second-class navigator in this country and, apart from the fact that pressure is still given in inches of mercury, English pilots would find that the several chapters would amply repay careful reading.

In plan it follows conventional lines and deals in turn with a weather bureau; the various weather elements; the weather map; the relation between wind and pressure, the vertical structure of the atmosphere, convection, &c.

The chapter on the construction of a weather map is especially clearly written. It is a subject which to the average aviator is fuller of snags than the expert generally realises, while the formation of ice on aircraft and the means of combating the same, is a topic not without importance, even in England, and useful information is given under this heading.

There are one or two minor blemishes. The definitions of dense fog given on pp. 31 and 32 are somewhat contradictory, while instability is hardly a character which one would apply to the air in a warm sector (p. 100), but on the whole the book fulfils its purpose in a thoroughly commendable manner.

S. F. Witcombe.

Smithsonian Meteorological Tables. 5th revised edition. Size 9 × 6 in. pp. lxxxvi + 282. Smiths. Inst. Misc. Coll. 86, 1931.

These tables will need no recommendation to those who have had occasion to use the earlier editions for finding their way in the confusion of units which afflicts meteorology, involving computations in barometric inches, millimetres and millibars, Fahrenheit, Centigrade and Absolute temperatures, inches and centimetres, feet and metres, miles per hour and metres per second. The changes which have been made since the publication of the previous edition in 1918 mainly reflect innovations in meteorological practice since that date; the introduction of the "dynamic metre" in upper-air work involves the addition of five new tables; the list of international meteorological symbols now includes those for mirage, exceptional visibility and duststorm. A new table shows the energy distribution and atmospheric transmission of solar radiation. The tables for computation of mean wind direction by Lambert's formula have been omitted—this is little to be regretted as in practice the computation is easily carried out with the aid of a slide-rule. The new edition is said to be corrected to January, 1931. The energy of the Smithsonian Institution in keeping these tables abreast of current meteorological practice is much to be commended.

S. T. A. MIRRLEES.

Soil Temperatures in the United States. By Edith M. Fitton and Chas. F. Brooks. Reprinted from the Monthly Weather Rev., Washington, D.C., 59, 1931, pp. 6-16.

Observations of soil temperatures for 32 stations in the United States are discussed in this paper. From the data available comparisons are made between air and soil temperatures, and the variations of diurnal and annual range of temperature in various soils, under different cover crops and at different depths are noted.

Tables of mean monthly soil temperatures and diurnal and monthly range are given, with a comprehensive bibliography.

Books Received

Apia Observatory, Samoa. Report for 1927. Wellington, 1929.

Die Forschungsstation auf dem Jungfraujoch (3,457 m.), by Dr. W. Mörikofer (reprinted from xxxix Jahresbericht des Sonnblick-Vereines, 1930. Wien, 1931).

Obituary

Mr. Wilson A. Bentley.—We regret to learn of the death on December 23rd, 1931, of Mr. Wilson A. Bentley. Mr. Bentley was a farmer in Vermont, and all his life he made a hobby of photographing snow crystals, of which he formed a collection of more than 5,000. Shortly before his death a selection of these, the sifted results of 46 years' labour, were published in the form of an album, with a descriptive preface by Dr. W. J.

Humphreys. A review of this book will appear in the April issue of the *Meteorological Magazine.*

News in Brief

Dr. W. J. Humphreys has been appointed Editor of the *Monthly Weather Review* in succession to the late Professor Alfred J. Henry.

Dr. Charles F. Brooks has been appointed Director of the Blue Hill Meteorological Observatory and Professor of Meteorology at Harvard University, in succession to Professor A. McAdie, who is retiring.

Mr. Andrew Thomson has resigned from the New Zealand Meteorological Service to become meteorologist in the Canadian Meteorological Service at the Central Office in Toronto.

A cheerful company assembled at the Royal Hotel, Woburn Place, London, W.C.1, on February 12th, for the 13th Annual Soirée of the Meteorological Office. Dancing occupied a large part of the evening between 7.30 p.m. and midnight, but time was found for two generous items of entertainment by Mr. Leonard Henry, one or two competitions with prizes and, in addition, an interval for refreshments accompanied by that necessary ingredient of a soirée, conversation.

The attendance was somewhat smaller than usual, especially as far as the nearer outstations were concerned, but no doubt this was due more to budgetary considerations, than to the fact that this soirée was the 13th of the series.

The Eleventh Annual Dinner of the staff of the Meteorological Office, Shoeburyness, was held at the Queen's Hotel, Westcliff, on February 6th.

The Weather of February, 1932

The main characteristics of the weather of February over the British Isles were abnormally high barometric pressure, unusually dry weather and a persistence of northerly and easterly winds. On the whole, too, conditions were mild in Scotland, but cold elsewhere. The anticyclone régime which was inaugurated in the last ten days of January persisted throughout February.* No centre of low pressure crossed the country during the month. The general paucity of rainfall was remarkable. Many places recorded " absolute droughts " of varying duration. At Trecastle (Brecon), Seathwaite (Cumberland), Cranmere (Devon), and several places in Scotland,† the drought lasted the whole month, at Liverpool from the 4th 29th, at Lyndhurst (Hants), from the 1st-22nd. Many of the totals were also the smallest for this month since records began. At Ross-on-Wye a smaller February rainfall has been recorded in only two years, 1891, 1895, since records commenced in 1818. In England and parts of Ireland there were two spells of very cold weather, both due to the incursion of strong easterly winds from the interior of the continent. Gales occurred locally in the southern part of the country on both occasions. In the first spell, 10th-12th, snow fell over the whole of Great Britain, the Channel Islands and eastern Ireland, a depth of 1½ in. was recorded at Birmingham on the 12th, but generally the amounts were small. In spite of sunny intervals temperature was very low during this period, remaining below the freezing point on the 10th in east and south-east England and the Midlands; 28° F. was the maximum at Croydon, Lympne and Rothamsted. The second cold spell occurred on the 28th and 29th when a maximum of 33° F. was recorded at Boscombe Down on the 29th. The 19th was also a very cold day in the Midlands. One of lowest minima in the screen for the month was 18°F. at Markree Castle on the 19th. In Scotland temperature rarely fell below 40° F. throughout the month and exceeded 50° F. on some occasions, 54° F. was recorded at Renfrew on the 19th, and at Dundee, Leuchars and Renfrew on the 23rd. Sunshine totals for the month were generally below normal except in parts of west Scotland, Wales and west Ireland; Eskdalemuir had as much as 48 hours in excess of the normal. The sunniest days of the month were the 10th, 18th, 21st, 27th and 28th, also the 6th in the south-east, and the 15th and 19th in the west and north; on all of these days over 8 hrs. bright sunshine was recorded locally. Hastings had 9·1 hrs. and Brighton 9·0 hrs. on the 18th. The distribution of bright sunshine for the month was as follows :—

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* See page 29. † See page 32.

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	67	+ 9	Liverpool	59	— 9
Aberdeen	59	—14	Ross-on-Wye	58	—13
Dublin	52	—21	Falmouth	87	+ 4
Birr Castle	62	— 5	Gorleston	76	— 5
Valentia	81	+12	Kew	46	—14

The special message from Brazil states that in the northern and central regions the rainfall was scarce with 1·65in. and 0·24in. below normal respectively, while in the southern regions it was copious with 1·22in. above normal. Conditions favourable for the crops. Four anticyclones passed across the country. At Rio de Janeiro pressure was 0·8mb. below normal and temperature 0·7°F. above normal.

Miscellaneous notes on weather abroad culled from various sources. Snowstorms were experienced generally in eastern Greece and the

Black Sea on the 4th-6th and the 13th-15th, and bitterly cold weather accompanied by severe snowstorms in many places was recorded throughout France on the 10th and 11th; as far south as Marignane a maximum temperature of 31·5°F. occurred on the 11th, and a screen minimum of 14° F. on the night of the 11th-12th. In Loraine the heavy snowfall delayed many trains. Owing to the intense cold in Switzerland about the 15th, three people died and the rivers and minor lakes were frozen. Severe cold and heavy falls of snow were reported from south-eastern Europe from about the 20th to the end of the month. Heavy falls of snow also occurred in the region of Avellino and the Province of Molise (Italy) about the 20th. This snowy weather spread over Italy and France towards the end of the month. Snow was reported both from Rome and Naples on the 27th and also from Marseilles and Avignon. The rainfall which occurred at the end of the month in Cyprus is considered to have saved the wheat crop there, although it came too late to save the barley and the early lambs (*The Times*, February 5th-29th, 1931).

Snowstorms occurred over the Syrian Desert about the 7th and a little later Mosul experienced the severest cold recorded there for several years. Snow fell over nearly the whole Liwa (*The Times*, February 8th-11th, 1932).

The cyclone which struck Réunion in the Indian Ocean on the 5th was said to be the worst in the history of the island—45 people were killed (*The Times*, February 6th-10th, 1932).

Bush fires occurred round Melbourne early in the month following on 43 days' drought, but this was followed by heavy rains about the 5th. A long drought in the Canterbury Plain, New Zealand, was broken on the 19th (*The Times*, February 6th-20th, 1932).

Severe cold was recorded in Newfoundland during the first days of the month, the temperature at St. Johns was −8° F. on the night of the 2nd-3rd, and a temperature of −45° F. was reported from Badger in the interior. Except at times along the Pacific Coast and in the Mountain Region, temperature was above normal in the United States throughout the month and was over 20°F. above normal in the Missouri Valley during the week ending March 1st, while rainfall was about normal, except in the Gulf States during the week ending the 23rd, when it was considerably in excess. Severe gales occurred in the Atlantic and the Bay of Biscay about the 15th (*The Times*, February 4th-5th, 1932, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin*).

Rainfall, February, 1932—General Distribution

England and Wales	18	per cent of the average 1881-1915.
Scotland	12	
Ireland	7	
British Isles	14	

Rainfall: February, 1932: England and Wales

Co.	STATION	In.	Per-cent of Av.	Co.	STATION	In.	Per-cent. of Av.
Lond	Camden Square	·27	16	*Leics*	Belvoir Castle	·57	34
Sur	Reigate, Alvington	·54	25	*Rut*	Ridlington	·64	39
Kent	Tenterden, Ashenden	·53	27	*Linc*	Boston, Skirbeck	·66	45
,,	Folkestone, Boro. San.	·61	...	,,	Cranwell Aerodrome	·60	40
,,	Margate, Cliftonville	·30	22	,,	Skegness, Marine Gdns	·50	33
,,	Sevenoaks, Speldhurst	·65	...	,,	Louth, Westgate	·77	40
Sus	Patching Farm	·19	9	,,	Brigg, Wrawby St.	·54	...
,,	Brighton, Old Steyne	·07	3	*Notts*	Worksop, Hodsock	·43	28
,,	Heathfield, Barklye	·47	20	*Derby*	Derby, L. M. & S. Rly.	·26	16
Hants	Ventnor, Roy. Nat. Hos.	·08	4	,,	Buxton, Devon Hos.	·40	11
,,	Fordingbridge, Oaklnds	·04	2	*Ches*	Runcorn, Weston Pt.	·09	5
,,	Ovington Rectory	·15	6	,,	Nantwich, Dorfold Hall	·15	...
,,	Sherborne St. John	·11	5	*Lancs*	Manchester, Whit. Pk.	·09	5
Berks	Wellington College	·09	5	,,	Stonyhurst College	·13	4
,,	Newbury, Greenham	·16	7	,,	Southport, Hesketh Pk	·05	2
Herts	Welwyn Garden City	·26	...	,,	Lancaster, Strathspey	·07	...
Bucks	H. Wycombe, Flackwell	·21	...	*Yorks*	Wath-upon-Dearne	·43	26
Oxf	Oxford, Mag. College	·09	6	,,	Bradford, Lister Pk.	·76	32
Nor	Pitsford, Sedgebrook	·36	22	,,	Oughtershaw Hall	·75	...
,,	Oundle	·35	...	,,	Wetherby, Ribston H.	·41	24
Beds	Woburn, Crawley Mill	·23	16	,,	Hull, Pearson Park	·64	39
Cam	Cambridge, Bot. Gdns.	·25	20	,,	Holme-on-Spalding	·59	...
Essex	Chelmsford, County Lab	·23	16	,,	West Witton, Ivy Ho.	·53	32
,,	Lexden Hill House	·35	...	,,	Felixkirk, Mt. St. John	·97	57
Suff	Haughley House	·31	...	,,	Pickering, Hungate	·98	56
,,	Campsea Ashe	·50	36	,,	Scarborough	·77	46
Norf	Norwich, Eaton	·87	53	,,	Middlesbrough	·86	66
,,	Wells, Holkham Hall	·72	49	,,	Baldersdale, Hury Res.	·50	...
,,	Swaffham, The Villa	1·28	79	*Durh*	Ushaw College	1·04	65
Wilts	Devizes, Highclere	·07	4	*Nor*	Newcastle, Town Moor	·74	47
,,	Bishops Cannings	·10	5	,,	Bellingham, Highgreen	·61	24
Dor	Evershot, Melbury Ho.	·03	1	,,	Lilburn Tower Gdns.	·75	38
,,	Creech Grange	·13	5	*Cumb*	Geltsdale	·39	...
,,	Shaftesbury, Abbey Ho.	·06	3	,,	Carlisle, Scaleby Hall	·11	5
Devon	Plymouth, The Hoe	·04	1	,,	Borrowdale, Seathwaite	·00	0
,,	Launceston, Werringt'n	·07	2	,,	Borrowdale, Moraine	·05	...
,,	Holne, Church Pk. Cott.	·04	1	,,	Keswick, High Hill	·06	...
,,	Cullompton	·03	1	*West*	Appleby, Castle Bank	·37	13
,,	Sidmouth, Sidmount	·07	3	*Glam*	Cardiff, Ely P. Stn.	·02	1
,,	Filleigh, Castle Hill	·01	...	,,	Treherbert, Tynywaun	·14	...
,,	Barnstaple. N. Dev. Ath	·12	4	*Carm*	Carmarthen Friary	·02	1
,,	Dartm'r, Cranmere Pool	·00	..	*Pemb*	Haverfordwest, School	·08	2
Corn	Redruth, Trewirgie	·04	1	*Card*	Aberystwyth	·12	...
,,	Penzance, Morrab Gdn.	·03	1	,,	Cardigan, County Sch.	·02	...
,,	St. Austell, Trevarna	·09	2	*Brec*	Crickhowell, Talymaes	·25	...
Soms	Chewton Mendip	·11	3	*Rad*	Birm W. W. Tyrmynydd	·18	3
,,	Long Ashton	·05	2	*Mont*	Lake Vyrnwy	·18	4
,,	Street, Millfield	·02	1	*Denb*	Llangynhafal	·26	12
Glos.	Blockley	·24	...	*Mer*	Dolgelly, Bryntirion	·07	2
,,	Cirencester, Gwynfa	·09	4	*Carn*	Llandudno	·14	7
Here	Ross, Birchlea	·14	7	,,	Snowdon, L. Llydaw 9	·20	...
,,	Ledbury, Underdown	·18	10	*Ang*	Holyhead, Salt Island	·21	8
Salop	Church Stretton	·20	9	,,	Lligwy	·07	3
,,	Shifnal, Hatton Grange	·20	12	*Isle of Man*			
Worc	Ombersley, Holt Lock	·14	9		Douglas, Boro' Cem.	.15	5
War	Birminghm, Edgbaston	·29	17	*Guernsey*			
Leics	Thornton Reservoir	·57	34		St. PeterP't. GrangeRd.	·87	35

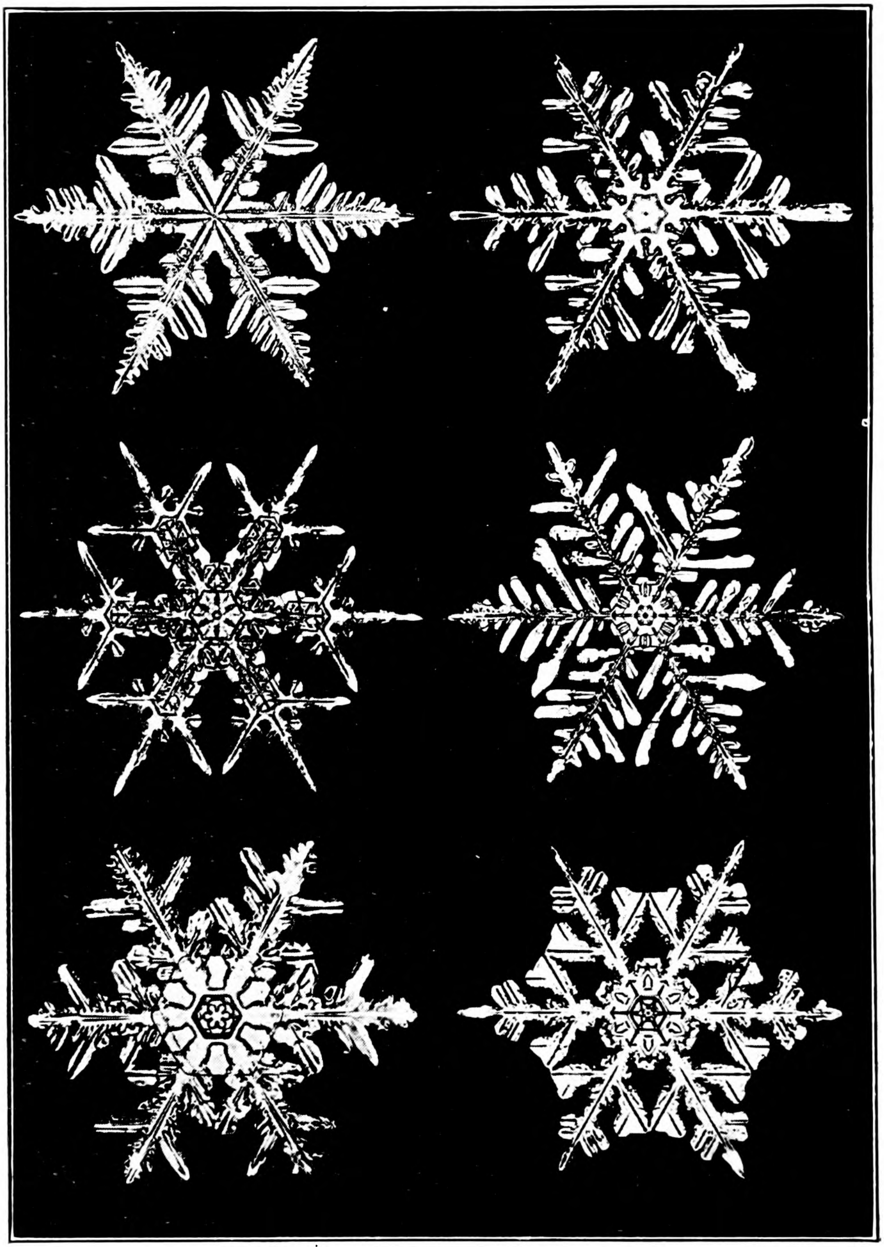
Rainfall : February, 1932 : Scotland and Ireland

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per cent. of Av.
Wigt .	Pt. William, Monreith	·01	0	*Suth* .	Melvich	·71	...
,, .	New Luce School	·04	1	,, .	Loch More, Achfary...	2·67	40
Kirk .	Carsphairn, Shiel	·17	3	*Caith* .	Wick	·54	24
Dumf.	Dumfries, Crichton, R.I	·07	...	*Ork* .	Pomona, Deerness	·66	22
,, .	Eskdalemuir Obs.	·18	2	*Shet* .	Lerwick	1·15	36
Roxb .	Branxholm	.26	10	*Cork* .	Caheragh Rectory	·67	...
Selk .	Ettrick Manse	·35	8	,, .	Dunmany Rectory	·72	12
Peeb .	West Linton	·25	...	,, .	Ballinacurra	·33	9
Berk .	Marchmont House	·67	32	,, .	Glanmire, Lota Lo	·18	5
Hadd.	North Berwick Res....	·33	21	*Kerry*.	Valentia Obsy	·45	9
Midl .	Edinburgh, Roy. Obs.	·18	11	,, .	Gearahameen	·40	...
Lan .	Auchtyfardle	·10	...	,, .	Killarney Asylum	·08	2
Ayr .	Kilmarnock, Kay Pk.	·05	...	,, .	Darrynane Abbey	·32	7
,, .	Girvan, Pinmore	·05	1	*Wat* .	Waterford, Gortmore...	·35	11
Renf .	Glasgow, Queen's Pk. .	·01	0	*Tip* .	Nenagh, Cas. Lough ...	·33	11
,, .	Greenock, Prospect H.	·00	0	,, .	Roscrea, Timoney Park	·14	...
Bute .	Rothesay, Ardencraig.	·22	5	,, .	Cashel, Ballinamona ...	·07	2
,, .	Dougarie Lodge	·05	...	*Lim* .	Foynes, Coolnanes	·12	4
Arg .	Ardgour House	·41	...	,, .	Castleconnel Rec.	·13	...
,, .	Glen Etive	·00	0	*Clare* .	Inagh, Mount Callan...	·10	...
,, .	Oban	·06	1	,, .	Broadford, Hurdlest'n.	·15	...
,, .	Poltalloch	·10	2	*Wexf*.	Gorey, Courtown Ho...	·17	6
,, .	Inveraray Castle	·03	0	*Kilk* .	Kilkenny Castle	·17	7
,, .	Islay, Eallabus	·09	2	*Wic* .	Rathnew, Clonmannon	·30	...
,, .	Mull, Benmore	2·00	...	*Carl* .	Hacketstown Rectory..	·36	12
,, .	Tiree	·26	...	*Leix* .	Blandsfort House	·30	11
Kinr .	Loch Leven Sluice	·11	4	,, .	Mountmellick	·32	...
Perth .	Loch Dhu	·10	1	*Off'ly* .	Birr Castle	·23	10
,, .	Balquhidder, Stronvar	·00	...	*Kild'r*.	Monasterevin	·17	...
,, .	Crieff, Strathearn Hyd.	·16	5	*Dubl* .	Dublin, FitzWm. Sq....	·19	10
,, .	Blair Castle Gardens...	·14	5	,, .	Balbriggan, Ardgillan.	·23	12
Angus.	Kettins School.	·16	8	*Me'th* .	Beauparc, St. Cloud...	·39	...
,, .	Dundee, E. Necropolis	·11	6	,, .	Kells, Headfort	·30	11
,, .	Pearsie House	·18	...	*W.M* .	Moate, Coolatore	·20	...
,, .	Montrose, Sunnyside...	·16	6	,, .	Mullingar, Belvedere...	·19	7
Aber .	Braemar, Bank	·18	6	*Long* .	Castle Forbes Gdns	·15	5
,, .	Logie Coldstone Sch....	...	...	*Gal* .	Ballynahinch Castle...	·22	4
,, .	Aberdeen, King's Coll.	·31	15	,, .	Galway, Grammar Sch.	·13	...
,, .	Fyvie Castle	·98	44	*Mayo* .	Mallaranny	·08	...
Moray.	Gordon Castle	·61	32	,, .	Westport House	·32	8
,, .	Grantown-on-Spey	·60	28	,, .	Delphi Lodge	·34	4
Nairn.	Nairn, Delnies	·44	24	*Sligo* .	Markree Obsy	·18	5
Invs .	Ben Alder Lodge	·14	...	*Cav'n*.	Belturbet, Cloverhill...	·02	1
,, .	Kingussie, The Birches	·19	...	*Ferm* .	Enniskillen, Portora...	·07	...
,, .	Loch Quoich, Loan	·60	...	*Arm* .	Armagh Obsy	·12	5
,, .	Glenquoich	·54	5	*Down*.	Fofanny Reservoir	·88	...
,, .	Inverness, Culduthel R.	·55	...	,, .	Seaforde	·15	5
,, .	Arisaig, Faire-na-Squir	·44	...	,, .	Donaghadee, C. Stn....	·12	5
,, .	Fort William, Glasdrum	·14	...	,, .	Banbridge, Milltown...	·18	...
,, .	Skye, Dunvegan	·63	...	*Antr* .	Belfast, Cavehill Rd...	·20	...
R & C.	Alness Ardross Cas....	·36	11	,, .	Glenarm Castle	·23	...
,, .	Ullapool	1·05	24	,, .	Ballymena, Harryville	·22	6
,, .	Torridon, Bendamph...	...	...	*Lon* .	Londonderry, Creggan	·25	8
,, .	Achnashellach	·90	...	*Tyr* .	Omagh, Edenfel	·25	8
,, .	Stornoway	·59	...	*D.n* .	Malin Head	·15	...
Suth .	Lairg	·43	14	,, .	Dunfanaghy	·49	...
,, .	Tongue	1·23	35	,, .	Killybegs, Rockmount .	·09	2

Climatological Table for the British Empire, September, 1931

STATIONS	PRESSURE Mean of Day M.S.L.	PRESSURE Diff. from Normal	TEMPERATURE Absolute Max.	TEMPERATURE Absolute Min.	TEMPERATURE Mean Values Max.	TEMPERATURE Mean Values Min.	TEMPERATURE Mean Values ½ max. and min.	TEMPERATURE Mean Values Diff. from Normal	TEMPERATURE Mean Wet Bulb	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION Am'nt	PRECIPITATION Diff. from Normal	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1021·7	+ 4·3	68	38	60·3	48·2	54·3	− 2·8	49·2	91	6·9	2·09	+ 0·22	10	3·9	31
Gibraltar	1016·1	− 1·2	83	57	78·7	64·4	71·5	− 1·0	63·4	85	4·7	1·46	+ 0·07	7	..	..
Malta	1015·7	− 0·6	93	62	79·8	69·3	74·5	− 1·5	68·3	73	3·3	0·65	− 0·62	4	9·2	74
St. Helena	1016·4	+ 0·2	67	52	59·5	53·6	56·5	− 0·9	54·3	94	9·7	2·51	..	18	..	..
Sierra Leone	1013·5	+ 1·3	87	66	82·9	69·4	76·1	− 3·0	75·4	89	7·9	27·27	− 1·21	23	..	..
Lagos, Nigeria	1012·5	− 0·3	88	70	83·6	74·9	79·3	+ 0·9	75·2	83	8·9	12·54	+ 7·28	20	..	..
Kaduna, Nigeria	1013·1	− 1·2	89	65	86·7	68·3	77·5	+ 2·2	72·0	87	8·3	9·25	− 2·24	24	..	..
Zomba, Nyasaland	1012·6	− 1·1	88	47	82·2	58·6	70·4	+ 0·9	..	54	1·8	0·42	+ 0·08	2	..	..
Salisbury, Rhodesia	1011·9	− 0·7	91	40	82·4	54·7	68·5	+ 2·1	52·6	31	1·2	0·00	− 0·28	0	9·8	82
Cape Town	1019·1	0·0	93	41	65·1	51·6	58·3	+ 0·4	53·3	84	6·9	2·24	0·00	15	..	..
Johannesburg	1015·5	− 0·3	88	25	72·5	48·2	60·3	+ 0·9	45·1	31	1·5	0·42	− 0·54	1	10·4	87
Mauritius	1018·9	− 1·3	81	57	78·3	62·8	70·5	+ 0·4	66·6	66	5·3	2·28	+ 0·98	10	8·9	74
Calcutta, Alipore Obsy.	1005·0	+ 0·5	94	75	89·7	79·3	84·5	+ 1·3	80·2	92	7·0	12·66	+ 2·65	15*	..	..
Bombay	1007·1	− 0·9	89	73	86·5	76·8	81·7	+ 0·8	76·3	83	7·6	4·48	− 6·20	9*	..	..
Madras	1005·6	− 0·9	99	75	91·7	77·6	84·7	− 0·5	75·8	74	6·3	8·53	+ 3·68	8*	..	..
Colombo, Ceylon	1009·9	0·0	86	73	84·4	76·8	80·6	− 0·6	77·1	79	7·3	5·54	+ 0·78	17	6·9	57
Singapore	1009·3	− 0·5	91	70	87·4	74·9	81·1	− 0·1	77·6	83	7·7	9·79	+ 3·02	21	5·4	44
Hongkong	1008·2	− 0·2	91	65	85·8	77·5	81·7	+ 0·7	76·9	77	6·8	13·43	+ 3·71	20	6·2	51
Sandakan	..	..	91	73	88·0	74·8	81·4	− 0·3	77·5	83	..	4·28	− 5·05	12	..	..
Sydney, N.S.W.	1014·1	− 2·0	90	42	68·5	50·9	59·7	+ 0·5	54·6	64	5·1	4·95	+ 2·09	8	7·1	60
Melbourne	1012·8	− 3·0	78	34	63·4	44·4	53·9	− 0·2	49·2	69	6·6	2·03	− 0·41	16	5·8	49
Adelaide	1014·2	− 3·3	81	41	65·7	48·1	56·9	− 0·2	51·8	63	6·4	2·79	+ 0·74	16	6·4	54
Perth, W. Australia	1017·2	− 0·8	70	41	63·8	50·5	57·1	− 1·1	53·2	69	7·6	5·27	+ 1·85	21	5·5	47
Coolgardie	1015·7	− 1·4	93	36	71·5	44·5	58·0	− 0·7	49·5	49	2·8	0·33	− 0·34	2	..	..
Brisbane	1016·7	− 0·9	86	45	76·2	55·5	65·9	+ 0·7	58·7	60	3·2	0·91	− 1·14	7	8·5	72
Hobart, Tasmania	1005·5	− 5·5	77	35	58·4	42·1	50·3	− 0·7	44·3	60	6·3	1·77	− 0·30	21	6·0	51
Wellington, N.Z.	1010·0	− 4·6	65	33	52·5	41·8	47·1	− 4·5	45·4	80	7·9	3·79	− 0·18	21	4·3	36
Suva, Fiji	1014·5	+ 0·2	84	67	79·3	70·2	74·7	+ 0·2	71·0	80	7·4	7·34	− 0·35	15	3·8	32
Apia, Samoa	1011·8	− 0·4	88	68	85·3	73·2	79·2	+ 1·0	76·4	77	5·5	5·47	+ 0·36	16	7·2	60
Kingston, Jamaica	1011·5	− 0·7	91	70	87·5	73·3	80·4	− 1·1	73·0	68	7·7	3·34	− 0·69	12	6·0	49
Grenada, W.I.	1013·1	+ 1·3	91	72	87·9	74·6	81·3	+ 1·0	74·6	76	4·5	12·97	+ 4·98	24	..	..
Toronto	1015·2	− 2·6	96	42	75·4	56·4	65·9	+ 5·6	58·7	82	4·9	2·18	− 0·49	12	7·0	56
Winnipeg	1010·9	− 2·9	96	33	70·3	49·6	59·9	+ 6·2	49·4	89	5·1	3·23	+ 1·01	12	6·6	52
St. John, N.B.	1013·9	− 3·5	71	40	62·3	49·6	55·9	0·0	52·1	83	5·9	5·18	+ 1·44	18	4·7	37
Victoria, B.C.	1015·4	− 1·0	69	46	61·0	50·5	55·7	− 0·4	53·6	90	5·9	2·28	+ 0·47	15	5·4	43

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.



SNOW CRYSTALS

(reproduced from "Snow Crystals" by W. A. Bentley and W. J. Humphreys, p. 181).

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The Fascination of Snow Crystals*

Every meteorologist who has given any attention to the forms of snow crystals is familiar with the beautiful photographs made by Mr. W. A. Bentley. Selections from Mr. Bentley's store have been reproduced from time to time. We have now to thank an anonymous admirer of the photographs for making possible the publication of a magnificent album containing more than two thousand illustrations. At the request of the American Meteorological Society, Professor Humphreys has collaborated with Mr. Bentley by assisting in the selection and classification of the pictures and by writing a lively descriptive introduction to the collection. There is only one fault to find with this introduction. We should have liked to see the pictures through Mr. Bentley's eyes and to learn a little more of his personality. What is he by trade or profession? What made him take up his fascinating hobby fifty years ago? Has he distinguished himself in other work with microscope and camera? Perhaps such questions will be answered in a second edition of the album, for the present one is published with the optimistic words " First Edition " on the title page.

As will be seen from the illustrations which we reproduce the photographs appear on a black background. This background is

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*Snow Crystals. By W. A. Bentley and W. J. Humphreys. Size 12 × 9½ in. pp. ix.+227, *Illus.* New York and London. McGraw-Hill Publishing Co. Ltd. 1931.

(97989) 107/27 1,075 4/32 M. & S. *Gp.303*

secured in an ingenious way. When the photograph is taken the crystal is flat on a microscope slide. The background of clear glass would appear white on a print. Mr. Bentley makes a duplicate negative and carefully cuts away the film round the picture. In the final print the background is black.

In England we may well be jealous of the opportunities enjoyed by Mr. Bentley for his work. His home at Jericho, Vermont, at no great height above sea-level, is about sixty miles from Montreal, so the climate is like that of eastern Canada. One gathers that isolated crystals are the usual form of snow. The photographer has had no temptation to portray the fluffy snowflakes with which we are familiar.

In looking at the pictures it is difficult to realise that the delicate lines which seem to be etched on the crystals are not really black. We are told that the crystals are often ridged. In taking the photographs the light of the sky is passed through a stop of small aperture before reaching the crystal. Light which falls on an oblique surface is refracted and never reaches the microscope lens. That is why ridges and furrows and the slopes of plateaus would appear black in the pictures. One wonders to what extent such surface irregularities are really responsible for the patterns in the pictures. Some of the markings are certainly internal. They indicate where growths from opposite directions have consolidated.

How far can we go in explaining on physical principles these wonderful designs?

We can make a start by utilising the results of X-ray analysis and elementary chemistry. The work with X-rays tells us that an ice crystal is built up on a simple plan. Think of a flat criss-cross pattern made of three sets of equidistant parallel lines. Of the equilateral triangles formed by these lines let half be shaded. Now suppose that a little pyramid (a regular tetrahedron) stands on each shaded triangle. The vertices of the pyramids mark the corners of a pattern like the first. The triangles to be shaded in the new pattern are those which come over the corners of the first one. More pyramids stand on the new shaded triangles. The process can be repeated indefinitely. Now suppose that there is an oxygen atom at each of the corners and also an oxygen atom at the centre of each tetrahedron. This is the distribution of oxygen atoms as revealed by X-rays. Chemistry tells us that there must be twice as many hydrogen atoms as oxygen ones and we satisfy this condition by tucking the hydrogen atoms between the oxygen atoms and their nearest neighbours, four hydrogen atoms in each tetrahedron. The scale of this structure is such that the minimum distance between the centres of oxygen atoms is 2·75 Ångström units and the sides of the little equilateral triangles with which our description commenced are 4·5 Ångström units. Since there are 10^7 Ångström units in a millimetre, a figure can readily be drawn with a magnification of 20 million.

The essential feature of the ground plan of the crystal structure is the equilateral triangle, but there are clearly six directions in which the plan can be extended without sacrifice of symmetry so it is not surprising that the hexagon is the typical form of ice. Crystals of triangular form are however well represented in the Bentley collection.

It is by no means certain that there is only one fundamental arrangement of the atoms of oxygen and hydrogen in ice. The fact that, whilst some crystals are flat plates, others are long prisms, suggests that under different circumstances of growth the elementary parts are arranged in different ways. The structure which we have described could be varied by supposing that the second set of triangles was located in such a way that the shaded triangles were not centred over the corners of the first set. The two types of ice crystal would be related in much the same way as the two forms of crystalline carbon, graphite and diamond. It is strange that no X-ray analysis of flat crystals, such as Mr. Bentley photographs, has been brought to the notice of meteorologists.

The condition which determines whether these regular crystalline forms of ice shall occur in snow crystals has been laid down recently by G. Stüve of Frankfurt. He considers that when moisture condenses on a nucleus of salt at a temperature a little below 32°F. the first condensation is in the form of liquid brine. As condensation proceeds the liquid droplets grow, collide and eventually freeze. The frozen droplets are irregular; they may grow into columnar forms as they fall, but they never become symmetrical snow crystals. On the other hand, says Stüve, if the temperature is below the freezing point of concentrated brine, about 0°F., then no liquid water will be deposited on the original salt of the nucleus; the deposit will take the form of ice and conditions will be favourable for symmetrical growth. So far as the significance of the limit 0°F. is concerned Stüve's theory might be tested by observation. What temperature is to be found in Ottawa when regular snow crystals are formed from the steam in the railway station?

Now we are faced with the question how a crystal grows. Looking at one of Bentley's pictures we are forced to admit that the symmetrical closed curves and polygons represent the boundary of the crystal at certain stages of growth. If Mr. Bentley had cut away his negatives along some of these curves he could have given us an instructive series of pictures representing the life-history of a single crystal. There are, however, but few cases in which the record is clear, in which one could give precise instructions as to where the film was to be removed.

Generally one has the impression that the process of growth must have been intermittent, that the artist paused when he had made a neat outline before deciding how to extend the pattern. There are moreover some cases in which it looks as if the plate had been completed before the design was sketched on the surface.

One can make an attempt at a physical explanation of symmetry in crystal growth. Inside the crystal there is a nice balance of electric force. We believe it is the electrical attraction between the negatively charged oxygen atoms and positively charged hydrogen atoms that holds them together. Round the edges and on the faces of the crystal there is a complicated electric field and molecules of water vapour coming into the field are liable to capture. As long as the crystal is symmetrical the electric field is symmetrical and the chance of capturing molecules is symmetrically distributed. Therefore the growth will continue to be symmetrical. The rate of growth will depend on temperature and humidity, and as each crystal, drifting through strata of varying water content, has a different history, each crystal develops its own special pattern.

That story is very nearly plausible, but I must confess that when I look back at the photographs I am not satisfied. I cannot help feeling that there is a controlling force of which we know nothing. It seems as if there had been a master mind controlling a team of Maxwell demons and ordering them to place so many molecules simultaneously at corresponding points on all the edges of the crystal.

This example of the orderly development of crystal structure will surely have important lessons for the philosopher of the future; so we may hope that the publication of the Bentley album will, in due course, lead to fuller knowledge of the mysteries of space and time.

Postscript.—Readers of the *Meteorological Magazine* will be aware that since the foregoing article was written the death of Mr. Bentley on December 23rd, 1931, has been announced. He had lived to see the best evidence of the appreciation with which the work of his leisure hours was regarded by his scientific friends.

F. J. W. WHIPPLE.

Winds in London during the early 19th Century

By C. E. P. BROOKS, D.Sc.

During the course of a recent discussion at the Meteorological Office, Mr. D. Brunt called my attention to a period of abnormally high barometric pressure in Paris, at the beginning of the 19th century. I had previously noticed that the winds in London at that time presented some abnormal features, and it seemed that a detailed study of the variations of wind direction during that period might have some interest. There is abundant material, though unfortunately, as will be seen, some of it is of poor quality. A search revealed the following series of observations:—

1. A weather diary in the library of the Royal Observatory, Greenwich, covering the period 1771-1821, kindly lent by the Royal Astronomer. Until 1774 this was kept at or near Kennington, then until June, 1782, at Muswell Hill, and for the rest of the period at Syon House, Isleworth.

2. A weather diary kept at the rooms of the Royal Society, Somerset House, from 1774 to 1780 and 1786 to 1825. A manuscript copy of this is in the library of the Royal Meteorological Society.

3. A weather diary kept by the Rev. W. Cowe, M.A., at Sunbury Vicarage, Middlesex, from 1795 until 1839. This was reproduced photographically and published in a limited edition in 1889.

4. A weather diary at Somers Town from 1811 until 1842. This is in the library of the Royal Meteorological Society.

5. A series of observations by Luke Howard at Plaistow, Stratford and Tottenham, published in the second edition of the "Meteorology of London."

6. A series of observations at Chiswick from 1826 to 1840. Summaries of these are given in the "Report upon the meteorological observations made in the Garden of the Horticultural Society," published annually in the "Horticultural Transactions."

7. The record of the anemometer at Greenwich Observatory, which commences in 1841.

The first four of these series had not previously been summarised, and the first step was to prepare monthly tables of wind frequency for each year; this was done with the assistance of Miss T. M. Hunt. These tables are being typed and copies will be filed for reference, but the figures in this form are far too bulky to handle. They were accordingly reduced to "direction frequency vectors," each observation being given unit value irrespective of velocity. This process of course does not give the resultant air movement, but it gives a fair representation of what may be termed the "wind climate." Except at low speeds, the direction of the wind is a good indication of its origin and characteristics. Also, it was this or nothing, as no satisfactory indications of velocity are available before 1841. The components of the vectors from north and east were calculated separately, for each year and for each winter (December to February) and summer (June to August).

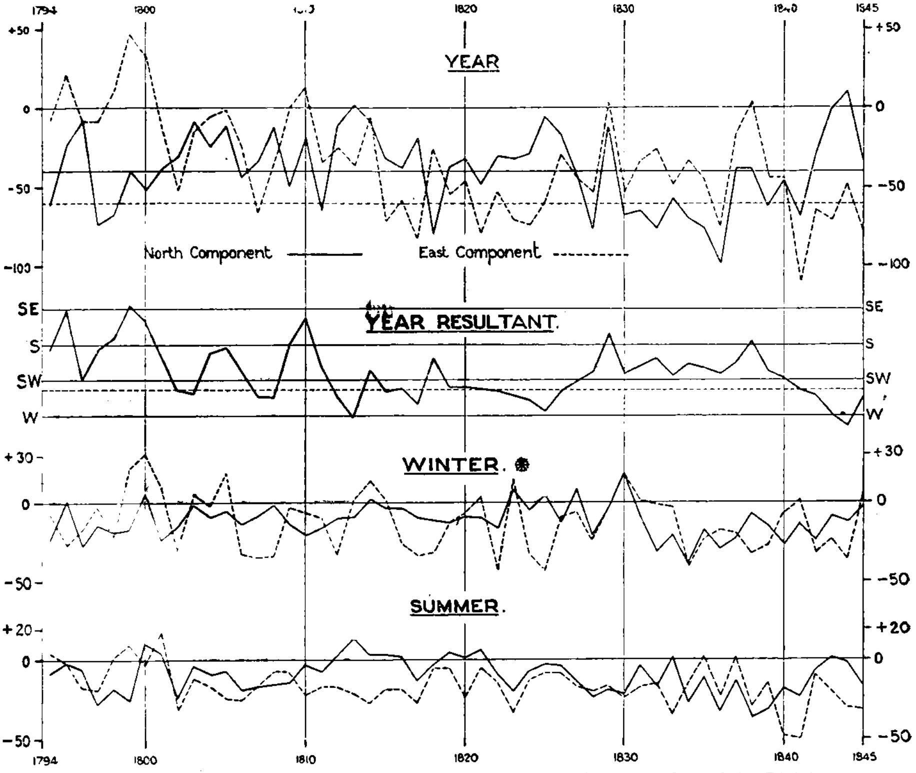
At this stage the components for the year for all stations were plotted on squared paper. The results were interesting, but also rather disappointing. For the period 1811 to 1821, which is covered by all the records except Chiswick and Greenwich, the curves of east component form a narrow band, indicating that all the records are in close agreement. The curves of north component are more widely scattered, and Luke Howard's observations especially showed a consistently large positive value. As this series is also very broken as regards locality, it was rejected. The remaining series show little trace of systematic differences, and their average probably eliminates most of the individual errors. After 1827, however, the Somers Town record shows a rapidly increasing frequency of north-westerly winds, probably because the vane was not balanced. If the broad tail of the vane was heavier than the head, as it often is, and the spindle became bent over towards the south-east, there would be a bias in favour of an apparent north-west wind, and this bias would tend to increase with time. Hence the Somers Town record was rejected after 1827. The earlier years were more difficult. Before 1795 we have only Syon House and the Royal Society. From 1794 onwards these two records are in good agreement, but before that date they diverge hopelessly, both in general trend and in minor details. The change from Muswell Hill to Syon House coincides with a marked apparent change in wind direction. The Royal Society record also shows some improbable features about 1790, due I think to friction of the anemometer. Hence it was judged best to reject the early years of both series, and to commence the study with the winter of 1793-4. After some experimenting with small corrections, the wisest decision appeared to be to take the actual means of the acceptable data as the wind components for London in each year, and these means were again plotted.

The results are shown in fig. 1, the three pairs of curves representing the year, winter and summer. The data for winter are entered to the year in which January and February fall, but include also December of the preceding year. The vertical scale represents the " direction frequency vector " on the scale of one unit per day, north and east being positive, south and west negative. The full line shows the component from north, the broken line that from east. Thus the resultant direction can be read off as follows :—

north curve +, east curve +, wind north-east
north curve +, east curve −, wind north-west
north curve −, east curve +, wind south-east
north curve −, east curve −, wind south-west.

The two horizontal lines traversing the diagram for the year, below the zero line, give the average components at Greenwich during the 60-year period 1860 to 1919, which happened to be readily available. The full line represents the north component, the broken line the east component. The isolated full line, which comes between the components for the year and those for winter, represents the resultant direction frequency vector calculated from these components. It was inserted to make the meaning of the components clearer to the eye. The broken horizontal line in this diagram shows the resultant at Greenwich from 1860 to 1919.

Considering first the curves of the annual components, it is seen that while the full curve oscillates about a nearly horizontal axis, the axis of the broken curve has a decided downward trend from left to right which continues throughout the first quarter of the 19th century. In other words, while the excess of southerly over northerly winds showed little variation during the period, there was a distinct tendency for easterly winds to be more frequent and westerly winds less frequent in the earlier years than in the later years.



* Winter refers to the period Dec.-Feb. eg Winter 1794 is Dec 1793, Jan, Feb, 1794.

Fig. 1.

The curve of resultant directions shows a remarkable swing from an average direction east of south between 1794 and 1800 to west-south-west after about 1810. This runs parallel with the variations of annual rainfall in England, which according to the figures compiled by J. Glasspoole* show a marked minimum from 1795 to 1805, and maximum from 1816 onwards, the succeeding minimum not occurring until the 1850's. In Scotland the rainfall was deficient during the years before 1810, both at Rothesay in the west and Edinburgh in the east, and increased markedly during the following years, the increase amounting to about 6 per cent. The long series of wind directions at Edinburgh, collected by R. C. Mossman* also show a marked change about 1810, but instead of being from south towards west, as it was in London, the change was in the reverse direction, from west towards south, and much smaller in amount. The figures are shown in the following table:—

**Meteorological Magazine*, 63, 1928, pp. 4-5.

TABLE I.—ANNUAL WIND FREQUENCY VECTORS.

YEAR	LONDON				EDINBURGH			
	Components		Resultant		Components		Resultant	
	N.	E.	Direction	Amt.	N.	E.	Direction	Amt.
1794-1810	—35	— 7	191°	36	0	—111	270	111
1811-1827	—31	—51	238	60	—41	— 79	242	89
1828-1840	—61	—36	210	71	—24	— 74	252	78

Directions are measured in degrees from north through east, 180° being south and 270° west. Components and amounts are in days per year.

When we turn to the pressure data, we find an equally remarkable change, also about 1810. Taking as a basis the same three intervals 1794-1810, 1811-1827, 1828-1840, we find that the mean annual pressures reduced to mean sea level were:—

Paris ... ... 1017·6mb., 1016·1mb., 1016·3mb.
Edinburgh ... 1011·7mb., 1012·1mb., 1012·3mb.

Between the first and second periods pressure fell no less than 1·5mb. at Paris, but rose 0·4mb. at Edinburgh.

It remains only to fit these curious facts together, and this is not difficult. During the first period, 1794 to 1810, there must have been a definite tendency towards the frequent establishment of anticyclonic conditions over France, giving the high pressure at Paris. This anticyclonic tendency extended northwards over southern England, but did not extend far to the west, so that near London the average isobars ran from south-south-west to north-north-east, giving almost southerly winds. Owing to the anticyclonic conditions, however, the winds were very variable, the magnitude of the resultant vector being only 36, or 10 per cent. Also the rainfall over England was small, another indication of frequent anticyclonic conditions. In south-eastern Scotland, on the other hand, the isobars ran from west to east and were crowded closely together, giving strong and steady westerly winds. The magnitude of the vector at Edinburgh is as much

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*The meteorology of Edinburgh. *Edinburgh, Trans. R. Soc.*, 38, 1896. Pt. III. No. 20, pp. 681-755 ; 39, 1897, Pt. I, No. 6, pp. 63-208.

as 111 days, or 30 per cent. These conditions are shown by the full lines and arrows in fig. 2. We may attribute the small rainfall at Rothesay to the westward divergence of the isobars, and at Edinburgh to a rain-shadow effect in the steady westerly winds.

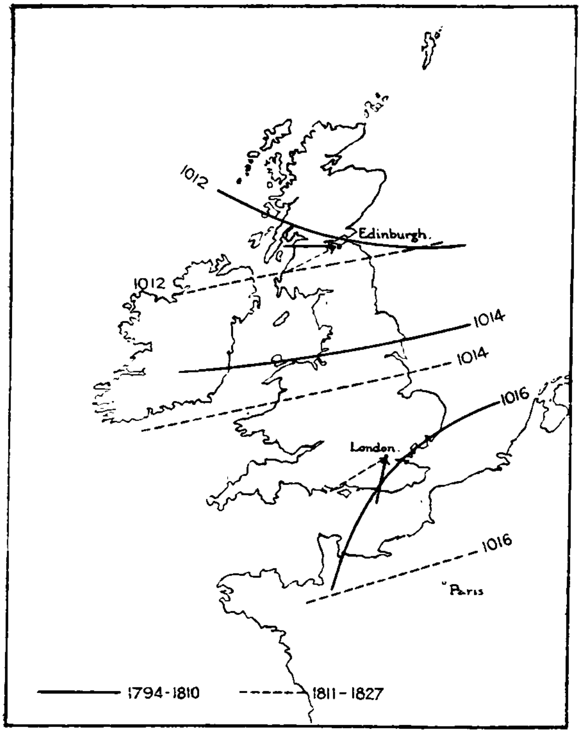

Fig. 2.

The broken lines and arrows in fig. 2 show conditions during the period 1811 to 1827. The wind arrows at London and Edinburgh, instead of being inclined almost at right angles, run practically parallel from between south-west and west-south-west, suggesting that the average pressure distribution over the British Isles now consisted of a series of parallel isobars running from west-south-west to east-north-east, while the relatively low pressure over Paris, the relatively heavy rainfall over England and Scotland, and perhaps also the decreased steadiness of the wind at Edinburgh, point to depressions crossing England with increased frequency. The whole is a surprising example of the amount of information which can sometimes be drawn from the scanty data of the early days of meteorology.

The pressure data indicate that similar conditions to those of 1794-1810 extended back towards the middle of the 18th century. Although the early wind records at London had to be rejected, it should be remarked that they point strongly to the prevalence of southerly winds from 1783 to 1793, as well as from 1794 onwards, and this result can probably be accepted qualitatively though not quantitatively.

The curves for winter and summer are of interest for the student of severe winters and hot summers. Without going into detail, it may be mentioned that of the years which gave a resultant wind from north-east in winter, namely 1800, 1814, 1823 and 1830, the first was not especially cold, but the winter of 1813-4 was the most severe of the century, and was the occasion of a notable " frost fair." The winters of 1822-3 and 1829-30 were also very cold in London. The mean temperatures of these four seasons were respectively 37·3°F., 31·9°F., 34·9°F. and 33·3°F., compared with a " normal " at Greenwich of 39·5°F. It may perhaps be surmised that during the winter of 1799-1800, which had an almost normal temperature in spite of the frequent north-east winds in London, the conditions resembled those during February, 1932,* with an isolated anticyclone to the north-west, so that the source of the air which reached London lay over the Atlantic to the northward. During the winter of 1813-4, on the other hand, it may be surmised that the high pressure to the north of England formed part of a long anticyclonic belt extending eastwards over northern Europe, as in February, 1929, so that the source of the air lay in northern Russia or Siberia.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday evening, March 16th, at 49, Cromwell Road, Prof. S. Chapman, F.R.S., President, in the Chair. As is customary in March the meeting took the form of a lecture (The Symons Memorial Lecture), which was delivered on this occasion by Dr. B. A. Keen, F.Inst.P., Assistant Director, Rothamsted Experimental Station, his subject being

Soil Physics in Relation to Meteorology.

Although the physical properties of the soil are of vital importance in agriculture it is only in the past 15 years that they have been studied in detail by competent physicists. The Soil Physics Department at Rothamsted, which is in Dr. Keen's charge, is now recognised as the leading centre for this work. The lecturer introduced his subject with a description of the different soil types found in different climatic zones. In discussing soil temperatures it was pointed out that the porous and moist nature of soil produced special effects. In particular the downward percolation of water appreciably reduced the loss of heat from the soil. A full account was given of recent investigations at Rothamsted on the movement and distribution of water in the soil. It was shown that such movements are much less both in amount and extent than was previously supposed. Water which has reached a depth of about 6 feet in the average soil is not drawn back to the surface again by evaporation. Many of the farmers' and gardeners' cultivation operations were supposed to conserve this sub-soil water for use by plants, but the explanation has now to be sought for in other directions. The lecture concluded with a review of the development of cultivation implements from the rudimentary form of a pointed stick, which merely stirred the ground, to a wide range of different types now in use.

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* *Meteorological Magazine*, 67. 1932, p. 29.

Mr. Richard Inwards, who was born in April 1840, was elected a Fellow of the Society in 1862, and has now been a Fellow for 70 years. Mr. Inwards served as President in 1894-5.

Another Fellow of long standing, Mr. John Hunter, of Belper, Derbyshire, who was elected in 1877, recently celebrated his golden wedding.

Correspondence

To the Editor, *The Meteorological Magazine.*

Summer Thunderstorms

The annual census of summer thunderstorms in the British Isles will be commenced on April 1st next. I shall again very much appreciate the valuable help of your readers in the work of observation. The main details required are the place, date and time of the occurrence between April 1st and September 30th next, of thunder, lightning or hail, with direction in which the lightning is seen, especially at night. In the case of actual thunderstorms additional information of the following character will be welcome :—

1. Time of first observation of thunder or lightning, with direction and estimated distance.
2. Time of commencement of very heavy rain or hail, *or* approximate time of nearest approach of storm, with direction and estimated distance.
3. Approximate time of final observation of thunder or lightning, with direction.
4. Severity of storm; changes in direction or strength of wind, changes in temperature, &c., during the storm.

It is essential that the position from which the observation is made should be specified by mentioning the approximate distance and direction from a railway station or other point which may be identified on a large scale map. Please state whether the times are those shown by public clocks or Greenwich Mean Time.

In thanking all those who were good enough to send in data last summer I may mention that a report is in preparation and will be forwarded to observers in the course of a few weeks.

S. Morris Bower.

Langley Terrace, Oakes, Huddersfield. March 31st, 1932.

Observation of Aurora at Aberdeen, March 28th, 1932

The aurora when first observed at 20h. 30m., G.M.T., had the form of an arch, faint, white in colour with little or no shimmering, elevation about 10°; the arch increased in brilliance, and rose in elevation to between 25°-35° by 21h. 10m., showing as a homogeneous arc stretching from north-west—north-north-east with a fainter glow below it. Between 20h. 45m. and 21h. 15m. there was considerable streamer activity to the north-north-west, the rays pulsating from the arc almost to the zenith. The aurora gradually faded to just a faint steady glow by 22h. 30m., after which time nothing further was noticed, this probably being due to the glare of the street lights on the slight haze. During the whole time I watched this display there was little or no change of colour except in the extreme north-west, from which quarter there appeared to be a pale greenish glow.

It might be of interest to note that the edges of some bands of lenticular alto-cumulus appeared to be lit up by the auroral light; also to the north-west an isolated lenticular-shaped cloud apparently of still higher alto-cumulus type, had not only its edges but its lower surface lit up; this phenomena being first observed just before 20h. 30m. while the aurora was moderately faint or only just visible.

J. F. OLIVER.

The Observatory, Aberdeen. March 29th, 1932.

Solar Phenomena observed at Hastings

At 16h. 45m. G.M.T. on March 25th, 1932, a parhelion was observed to the left of the sun while at the same time cloud in the vicinity and also to some distance from the sun showed iridescent colouring, the most striking colour being a brilliant green. After a short period another and brighter parhelion was observed to the right of the sun, and between 17h. 30m. and 17h. 40m. a white sun-pillar was seen extending slightly below the sun, and upwards almost to a slightly curved arc of contact situated about 22° from the sun. Although the pillar was visible to the naked eye, it was best seen with the black mirror owing to the brilliancy of the sun at the time. The phenomenon faded before 18h. but the contact arc, with diminishing intensity remained visible almost to sunset. At no time was the ordinary halo observed. These phenomena were observed in cirrus and cirro-stratus cloud moving from between south-west and west-south-west with a surface wind between ESE. and E. moderate to fresh in force. The interference colours also observed were, however, observed in a slightly lower cloud of a high type of alto-stratus.

A. E. MOON.

39, *Clive Avenue, Clive Vale, Hastings. March 28th*, 1932.

Optical Phenomena

Unusually brilliant and luminous mock suns were observed on March 25th from 2 p.m. to 5 p.m. together with a very bright prismatic upper arc of 22° halo. Up to 4 p.m., only a small amount of lenticular cirrus was present, the sky being of a deep blue and the sun showing a sharp disc. After 4 p.m., cirrus and cirro-cumulus, both of a lenticular type, increased considerably.

At 6 p.m. on the same date, a white sun pillar was visible extending about 15° above the sun, and showed a marked glittering effect.

An unusually red sunrise, the redness extending over the whole sky, occurred on the 26th.

Popular prognostics were borne out by the succeeding unsettled and stormy conditions.

SPENCER RUSSELL.

Worcester Park, Surrey. March 30th, 1932.

Fronts

Col. Gold's letter in the March issue leads to the general question of the blunting of thermal fronts or discontinuities by mixing processes or by travel over the surface of land and water.

When persons who stand on the fringe of meteorology question me about the reality of "fronts," my reply is always to the effect that the conception has proved invaluable in forecasting and in interpreting many anomalies in weather and climate, but that fronts are no more fronts in the literal sense than a snow-line, about which geographers and climatologists talk so glibly, is an actual line instead of being in most instances a pretty wide transitional belt between all snow and no snow. A meteorological "front" is scarcely such a sharply defined discontinuity as a geological fault, and one's experience suggests that as a rule the full change of temperature and humidity that accompanies a sudden shift of wind is not felt till a width of some miles of air have passed over a place, even in the case of narrow V-shaped depressions and line squalls. Perhaps those who work in daily contact with weather charts will state their experience in this matter.

Another matter that is causing trouble outside purely meteorological circles is the use of the term "polar front." This, to my mind, is nothing more nor less than a generalized pictorial expression of the fact that cold dry air drains away from the polar refrigerators and some time, somewhere and somehow finds itself confronted with warm humid tropical air at sufficiently close quarters for a cyclonic disturbance to ensue. But it is only locally and temporarily at least in the complex conditions of the northern hemisphere that this generalized polar front can be identified with the actual fronts of daily weather.

L. C. W. BONACINA.

35, *Parliament Hill, Hampstead. March 29th,* 1932.

[Mr. Bonacina's general description seems a fair one; there is, however, a radical distinction between a "front" and a snow-line or geological fault. The latter are static and relatively permanent—a front is in a moving medium and, relatively, transitory.—E. GOLD.]

NOTES AND QUERIES

Academia Nacional de Ciencias Antonio Alzate

The Sociedad Cientifica "Antonio Alzate" of Mexico (founded on October 4th, 1884) has been constituted as the National Academy of Sciences under the title of Academia Nacional de Ciencias Antonio Alzate. Its offices and library have been established in the new building that the Federal Government has granted to it at Justo Sierra Street No. 19.

Rapid Falls of Barometric Pressure

In response to an inquiry a search was made recently in the Meteorological Office Library to find the most rapid recorded fall of the barometer in a short period. As information of this nature is often difficult to obtain readily, it seems desirable to place the results on record.

Three examples of rapid falls of pressure were noted, all of them in tropical hurricanes. The first is quoted in Alexander Buchan's "Handy Book of Meteorology" (Edinburgh and London, 2ed. 1868). He writes (p. 266): "Thus, during the hurricane which devastated Gaudeloupe on the 6th September, 1865, it is stated in the *Bulletin International* that the barometer at Marie Galante, a neighbouring island, was 29·929 inches at 4 a.m., 29·646 at 6.30 a.m., 29·174 at 6.47 a.m., and 27·953 at 7.40 am., having thus fallen 1·693 inches (57·3mb.) in one hour and ten minutes."

The second example is from the *Quarterly Journal of the Royal Meteorological Society*, Vol. 28, 1902, p. 39. A barograph trace is reproduced, obtained on board the "Laisang," which left Hongkong for Japan on July 30th, 1901, and encountered a typhoon on August 2nd, somewhere to the northward of the Formosa Channel, in about lat. 25°N., long. 122°E. The pen of the barogram left the chart, but the lower part of the curve was plotted from readings of a mercurial barometer. From this chart it appears that at 8.30 p.m. the reading was 28·35 inches. The barometer is stated to have read 27·35 inches at 9 p.m. The fall was thus approximately one inch (34mb.) in half an hour.

The third example is from the *U.S. Monthly Weather Review*, Vol. 58, 1930, p. 363, and refers to a storm encountered by the steamship "Coamo," on September 3rd, 1930, near Santo Domingo. At one minute past one the pressure was 27·70 inches and a note states that "Pressure fell 0·08 in 1 minute, 1 p.m. to 1·01 p.m.; 0·20 in 3 minutes, 12.45 p.m. to 12.48 p.m.; 1·23 (41·6mb.) in 40 minutes, 11.20 to noon."

It is interesting to find that if the five readings given above are plotted they fall readily on a smooth curve passing through the origin, which gives the greatest fall in one hour as 53mb. Greater falls have no doubt occurred, but at such low readings the pen of the barograph leaves the chart and the record is usually lost. Exceedingly rapid, almost instantaneous falls also occur in tornadoes, but the barometer recovers within a few minutes; moreover the area covered by the centre of these storms is so small that there is little chance of obtaining a record.

Severe Thunderstorm in Fiji

Capt. E. W. G. Twentyman reports that a severe thunderstorm occurred in Suva, Fiji, on November 20th, 1931. The early morning was fine, clear sky and calm. At about 10h. a dense cumulo-nimbus cloud formed to the north, gradually covering the sky. Occasional distant thunder and lightning occurred. At 14h. 30m. the gentle SE. wind began to lull, followed by a squall of 14 m.p.h. at 14h. 40m. from N. by W., and severe thunder and lightning. Another squall of 20 m.p.h. occurred at 14h. 53m. accompanied by a torrential downpour, the wind falling off at 15h. At 15h. 3m. the wind came in from the ESE. increasing to 25 m.p.h. at 15h 10m., thence rapidly falling off and working to SSE. Thunder, lightning and rain ceased at 15h. 15m., 1·26in. of rain being recorded in the 22 minutes. Distant thunder and lightning occurred to the north between 16h. 25m. and 20h.; drizzle 16h. 35m. to 17h. 50m. The sky cleared about 21h. During the thunderstorm at approximately 14h. 54m. a horse was struck and killed by lightning on the wharf reclamation 367 yards north-east of this office. An Indian attending the horse received a severe shock but was otherwise unhurt.

A resident of Nasoli on the Rewa River reports that a severe thunderstorm occurred there on the 20th, accompanied by torrential rain and hail. The latter phenomenon is rather unusual for Fiji and had a very peculiar effect on the natives.

The "Spring" Drought of 1932

Droughts in the south of England are by no means uncommon, but wet weather often occurs concurrently in the north-western half of the British Isles. The rainfall of the six weeks January 21st to March 3rd was unusual in that while there was some rain everywhere in the British Isles the amounts were always small. After a few days of appreciable rainfall there was generally a renewal of dry weather until March 19th, but in the northern half of Scotland wet weather continued.

Many stations reported unusually long partial droughts (periods of 29 consecutive days or more the mean daily rainfall of which does not exceed 0·01 inch). At Camden Square (London) there was no rain at all during the 19 days from January 22nd to February 9th, and the total rainfall for the 64 days, January 17th to March 21st, amounted only to 0·51in. Absolute droughts exceeding 19 days at Camden Square have occurred on 31 occasions since 1858, while partial droughts exceeding 64 days have occurred only twice, viz., June 4th to August 11th, 1921 (69 days), and February 28th to May 16th, 1893 (78 days).

The drought of 1932 was experienced over an exceptionally large area. At Keswick, in the English Lake District, the total rainfall January 25th to March 3rd was only 0·06in.; at Glenquoich, in the western Highlands of Scotland, from February 3rd to March 3rd only 0·44in., and at Galway from January 25th to March 19th (54 days) only 0·54in. The partial drought which occurred during the spring of 1893 lasted much longer in the south of England than that of 1932, and a number of longer periods of no rain in certain localities are on record. It would be difficult, however to find a similar period of six weeks with as little rain over the British Isles as a whole.

Statistics for February, 1932, which comprised most of the drought, are readily available. Only a few isolated stations reported no measurable rain during the month. About 95 per cent. of the British Isles received less than 1in. and half the whole area received less than 0·25in. The observers at Seathwaite and at some other stations in the English Lake District, where readings are made once a month only, reported no measurable rain, and it can be assumed that any precipitation there was less than a tenth of an inch. At Rosthwaite, in Borrowdale, where daily readings are made, the total was 0·05in. So little rain has not been recorded at Seathwaite since the record was started there in 1845. At Glenquoich, the total of 0·54in. was less than that of any month since before 1868, the previous smallest total being 0·63in. for September, 1894.

The general rainfall over the British Isles during February, 1932, was 0·5in. and the month ranks as the driest since comparable statistics became available in 1870. The general rainfall for England and Wales was 0·5in., for Scotland 0·5in., and for Ireland 0·3in. There were, however, about six drier months over England and Wales since 1870, of which June, 1925, and February, 1891, with 0·1in. are the most striking.

An endeavour has been made recently to estimate the general rainfall over England and Wales since 1727, and the statistics are being published in *British Rainfall*, 1932. An examination of these statistics suggests that months as dry as or drier than

February, 1932, have occurred on about 25 occasions in the 206 years, *i.e.*, once every 8 years. It is noteworthy that these dry months occur mainly in groups: between 1921 and 1932 there were five such months; between 1891 and 1896 three, 1840 and 1844 two, 1800 and 1809 three, 1781 and 1790 four, 1740 and 1743 six. These groups are not remarkable either for unusually dry or wet years.

The first three weeks of January were unusually wet, especially in the west of the British Isles, and there was widespread rainfall towards the end of March. Although the total rainfall January to March, 1932, was below the average the deficiency was not remarkable. The general amounts expressed as a percentage of the average, are set out below: England and Wales 75, Scotland 91, Ireland 69, British Isles 77.

J. GLASSPOOLE.

Reviews

The Combination of Observations. By D. Brunt, M.A., B.Sc., Second Edition. 8vo. Size 9 x 6in.. pp. x + 239, *Illus.* Cambridge University Press, 1931. 12s. 6d. net.

It is probably true to say that the average meteorologist has no pronounced mathematical interests, and that what might be called the " science of figures " leaves him unmoved until such time as he is called on in the course of his work to interpret the results of experiment. He then wants to know what to do, without necessarily being required to know all the various assumptions that lie at the back of the theoretical methods that have been developed to this end. He is thus in somewhat the same position as the biologist who has to take a certain amount of the theory of observational error on trust. It is not one of the least of Mr. Brunt's services to science that he published, some fifteen years ago, a valuable compendium of information on the theory of errors of observation, a book that has been of very great assistance to the practical worker. The call for a new edition shows that the book is still appreciated. A wide variety of subject matter is embraced, and the book is one of a kind that must be becoming increasingly difficult to write in this age of specialisation. Beginning with the theory of error, treated along standard lines, the author proceeds to give a detailed treatment of least square theory, and no trouble is spared to cover all the possible cases that are likely to arise, or to illustrate the methods by means of numerical examples. The book then changes its character a little, and deals with certain statistical ideas, such as alternatives to the normal law of errors, correlation and regression. It is a little unfortunate for the underlying unity of treatment of the subject matter that it is still thought necessary to use a different notation for the biometrical part from that of the theory of error proper. This is largely a matter of history, but it is confusing to the reader, and one might hope that an author should find it possible to use the same symbol for the same thing throughout a book. This question of notation is one of the troubles in the subject dealt with, and it is not made any easier by the multiplicity of symbols in the various formulæ for "probable error." Finally we have chapters on Harmonic Analysis and the Periodogram.

Judged by the author's preface to the first edition, which has not been revised, the main theme of the book is the treatment of least squares, and it is not claimed that the last four chapters are more than introductions to the subjects discussed. It is in this last section, and in this only, that revision has been carried out in the new edition; minor alterations only have been made in the first eight chapters. A fuller treatment has been given of Pearson's development of a generalised system of frequency curves. Even so, however, it remains to a large extent academic, since there is obviously not the space to illustrate how the fitting is carried through in practical cases. A very brief discussion of multiple correlation has been added to Chapter X. These additions are welcome, but their choice only serves to emphasise the absence of many other portions of statistical theory which are of more immediate practical importance to the research worker. We must not expect too much of the author, for it is manifestly impossible to tack a complete manual of statistics on to a text-book of least squares, yet it may perhaps be urged that if choice was to be made the treatment of generalised frequency distributions might have been left for a more advanced text-book, and the space utilised in describing the practical tests of significance that take up most of the time of the statistical worker. There is a profound difference between the modern text-book on statistics and its predecessors; this book still belongs to the old school.

The chapters on Harmonic Analysis and the Periodogram are excellent. The author is an acknowledged expert in the field of Harmonic Analysis, and the chapter on this subject has been almost entirely rewritten, while its application to Periodogram analysis has been revised. One of the most interesting points discussed is the application of probability theory to the problem of the greatest amplitude of a number of periods brought about by purely random fluctuations, and the development of a criterion on this basis to test the significance of an observed period. We have a proof of the Schuster result, *i.e.*, the probability that R_S^2 shall exceed $\overline{\kappa R^2}$ is $e^{-\kappa}$, where the s'th harmonic is $R_s \cos(s\theta - \phi_s)$. $\overline{R^2}$ is the mean value of R_s^2 for all harmonics in a set of n observations, and is expressible in terms of the unknown standard deviation of the population from which the sample of observations is supposed taken. Sir Gilbert Walker's criterion follows, *i.e.*, the probability that at least one R^2 shall exceed the limit $\kappa\overline{R^2}$ is $P=1-(1-e^{-\kappa})^{n/2}$. Putting $P=\frac{1}{2}$ for an even chance this equation gives a relation between n and κ. Brunt goes on to observe very rightly that the parameter involved in $\overline{R^2}$ is not known *a priori*, and he modifies the formula to give it in terms of the calculated standard deviation (σ) of the sample. This work is so important as furnishing a criterion for the rejection of spurious periodicities that we are glad to see the matter taken up in some detail here. One can only wish that the author had gone a little further and referred to Fisher's recent and important work on the exact distribution of the ratio of the largest of the $\frac{1}{2}n$ squared amplitudes to their sample mean. For on two points the demonstration in the book before us is incomplete. First of all to put $P=\frac{1}{2}$ does not give a sufficiently rigorous criterion for the rejection of chance periods. Fisher considers the case $P=0{\cdot}05$, so that if the observed value for the ratio reaches that given in his table there is a 1 in 20 chance of the observed greatest amplitude having arisen by chance, and we may conclude that the data point to a real period. Secondly, Walker's criterion can only be applied exactly when the true value of σ is known, and it is therefore not enough to estimate σ from the sample and to use a theory based on σ being known exactly, but one should consider the exact solution based on the estimated standard deviation from the sample, and this is precisely what Fisher does. The mathematics of the demonstration is undoubtedly difficult, but the actual application of the test is so simple that it might quite well have found a place here, and Fisher's short table could have been reproduced.

We have dealt with this point in some detail because the problem must be one of the most important that are met with in Harmonic Analysis, and methods for dealing with it cannot be too widely known. Much more than this, of course, is included in Brunt's final chapter, and an exhaustive account is given of the various methods of detecting periodicities.

JOHN WISHART.

Pyrheliometric Measurements of Solar Radiation in Upsala during the years 1909-1922. By Martin Sjöström. Upsala, Soc. Scient. Acta., Series 4, Vol. 6, No. 6, 1930.

In this paper Sjöström gives a historical survey of all the work on solar radiation carried out at the Physical Laboratory, Upsala, during the years 1909 to 1929, with full references to the early work of K. Ångström, Lindholm and Granqvist, and the more recent developments by Anders Ångström and others. The transmission of the various filters used is discussed very fully in the second chapter, and tables of the transmissibility of the blue and green filters for different wave-lengths are given in detail.

The remainder of the paper, covering some 192 pages, gives in tabular form all the pyrheliometric measurements made at Upsala from February 20th, 1909, to November 25th, 1922. For each time of observation the tables give date, time of observation (apparent solar time), the calculated time altitude of the sun, the air mass taken from Bemporad's tables, the total intensity of solar radiation in gramme calories per cm^2 per minute, the intensities of the blue radiation and of the green radiation, the temperature, atmospheric pressure, absolute and relative humidity, and direction and strength of wind. On some days the number of observations was over 30, the weather being fine, and one day in April, 1912, 110 observations were made.

The student of solar radiation will find in these tables a mass of information of very great interest. The rapid variation of the total intensity of solar radiation which was observed on some days is very remarkable, but many other points of interest arise from a study of the tables. The book is a record of a very fine achievement, of which the Physical Laboratory, Upsala, may well be proud. D. BRUNT.

The Casella Patent Fortin and Patent Observatory Barometers, Leaflet No. 574. C. F. Casella and Co. Ltd. London, 1931.

Among the many instruments of interest displayed at the Physical and Optical Societies' Exhibition held recently at the Imperial College of Science, London, was Casella's patent Fortin barometer. Those who make use of the Fortin barometer are aware that it suffers from several defects. All will appreciate the difficulties that attend the accurate setting of the fiducial point flush with the mercury surface in the cistern. Within a short time the mercury surface, owing to impurities in, and dampness of the air, usually becomes contaminated and tarnishes.* Again, the glass cistern, which is made from drawn-glass tubing, also makes a clear view of the point and its reflection at the moment of contact difficult owing to striæ in the glass and distortion of the image from the optically imperfect glass surfaces. Obscurity is further increased by dirt settling upon the inner surface of the glass. Moreover, when the mercury surface in the cistern requires cleaning, it is the work of an expert to remove the lower part of the cistern, and upon reassembling the instrument a redetermination of the zero will be necessary. Finally, in most Fortin barometers the fiducial point is not secured to the metal scale but to the top of the cistern. Hence, any variation in the

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*For further information on this subject see the article entitled "The Contamination of mercury in barometer cisterns" by J. E. Belasco in the *Meteorological Magazine*, 63, 1928, p. 181.

tightness of the screws which hold together the upper and lower parts of the cistern will alter the distance of the fiducial point from the reading scale and will thus give rise to an error in the zero of the instrument.

In their patent Fortin barometer Messrs. Casella are to be congratulated in having successfully overcome these several difficulties. The cistern is of iron and the fiducial point, of rustless steel, is rigidly fixed to the metal frame and, therefore, at an unalterable distance from the divided scale. The air entering the cistern is purified by a filter so that the mercury surface will remain bright for a very long time. If, however, it should become necessary to clean the mercury in the cistern, it can be done by lowering the adjusting screw at the base of the cistern. The air can pass through the filter in and out of the cistern so freely that on setting the mercury in the cistern it settles down immediately to its proper level. By means of an optical system a beautifully clear definition of the fiducial point and its reflected image in the mercury surface is obtained under considerable magnification. Light enters the cistern through an optically plane disc fixed at the back of the cistern and after reflection from the mercury surface, is viewed through an adjustable eyepiece. Lastly, true verticality of the instrument is easily secured by rotating the frame of the barometer about its vertical axis and adjusting the three screws below the cistern until the fiducial point makes contact with the mercury surface in all positions. There is a sense of ease, pleasure, and confidence in using this instrument and we congratulate Messrs. Casella upon a fine achievement.

Messrs. Casella also exhibited their patent Observatory barometer, which is a form of Newman barometer. Observation of the fiducial point and its reflection in the mercury surface in the cistern is facilitated by an optical system similar to that in use in their Fortin barometer described above. The sliding vernier usually employed for setting to the top of the mercury column is dispensed with. Instead a very fine point is fused into the barometer tube. This tube is fixed inside a brass tube which is raised or lowered by a rack and pinion until the point comes in contact on the surface of the mercury. A fine adjustment screw brings the point into exact coincidence with its reflection, the point and its reflection being viewed through a microscope, the eyepiece of which is brought near to the scale divisions of the instrument by means of a system of prisms. On the outside of the brass tube is screwed a vernier which, as the tube moves up or down, travels alongside the scale divisions and permits readings of the barometer to be taken to 0·01 mm. When reading the barometer the point is set to the top of the mercury column and then the fiducial point (to which is attached the barometer scale) is set in the cistern. High praise is due to Messrs. Casella for their very ingenious method of overcoming the uncertainty which usually attends the setting of the vernier to the top of the mercury column. One need no longer be troubled when the mercury meniscus is flat.

J. E. Belasco.

Meteorological Observations for 1929. Prepared in the Meteorological Office, Wellington, New Zealand. Size $12\frac{1}{4} \times 10$in., pp. 23, Wellington, N.Z. Dept. of Scientific and Industrial Research, 1931.

Monthly summaries of the general climatological elements are given for some 49 stations, monthly sunshine totals for 26 stations, wind velocities (by Robinson anemometers) for 13 stations and pressure for 7 stations.

The rainfall for 1929 was, on the whole, slightly above normal. The year was remarkable for the comparative absence of westerly winds and for the unusual frequency of cyclonic disturbances. An unusually large number of heavy rains were recorded and many parts of the country experienced flooding. From June onwards low mean temperatures were recorded in each month, and vegetation was generally retarded by about a fortnight. The year was, nevertheless, a good one for those engaged in agricultural pursuits. J. Glasspoole.

Wetterhaftigkeit. By Gerhard Castens. Gerlands Beiträge zur Geophysik, Leipzig, 33, 1931, pp. 268-85.

This attempt at clarifying ideas on the subject of the persistence of weather types, *i.e.*, of the non-periodic variations in weather, is based chiefly on temperatures from Hamburg and Dar-es-Salaam, two towns which sufficiently represent the climatic contrast between middle and tropical latitudes. A method used by previous writers is the comparison of the hourly variations in temperature averaged for different months over several years. It is shown that this method is inadequate, even if the mean daily changes in the temperature are eliminated; in particular it fails to take into account the typical "April weather" at Hamburg. The time intervals for the temperature variations are then increased, taking as units 2, 4, 6, . . . 48 hours, and again 1, 2, 3, . . . 16 days. It is not until the interval becomes several days that results are obtained which give adequate expression to the climatic differences between Hamburg and Dar-es-Salaam, and in these results are indications of seven- and eleven-day periods. These conclusions are supported by a comparison of the ranges of temperature and pressure at the same stations. The paper concludes with some remarks on its bearing on forecasting, which appear rather more hopeful than practical.

A. F. Crossley.

Books Received

Summary of the Meteorological observations made at the Meteorological Stations in the Netherlands West Indies during the year 1930, compiled by the Royal Dutch Meteor. Inst., The Hague, 1931.

Deutsches Meteorologisches Yahrbuch für Bayern, 1930.

The Bavarian Meteorological Yearbook for 1930 contains as usual a number of valuable appendices, among which may be mentioned "Singularitäten im jährlichen Witterungsverlaufe auf der Zugspitze!" by A. Schmauss. "Beiträge zum internationalen Monat, Mai 1926," by L. Egersdörfer. "Die Zugspitzbahn-Versuche," by A. Büdel. "Witterungsbeobachtungen am Bodensee," by R. Holtzhey. "Die Münchener Registrierballonfahrten im Jahre 1930," by P. Zistler and H. Zierl.

Obituary

We regret to learn of the death at the age of 80 of the well-known astronomer, M. Guillaume Bigourdan, late Director of the Bureau International de l'Heure, Paris.

The Weather of March, 1932

Pressure was above normal over western United States, western Canada, Greenland, Iceland, northern and central Europe and northern Italy, the greatest excess being 5·8mb. at Skagen (Denmark). Pressure was below normal over the eastern United States, eastern Canada and across the North Atlantic to Morocco, south and west France, south Italy and the Balkan Peninsula, the greatest deficit, over 9mb., being near Nova Scotia. Temperature was about 12°F. and 4°F. above normal in Spitsbergen and in northern Sweden respectively, and about 4°F. below normal in south-east Sweden and Switzerland. Rainfall was generally two-thirds of the normal in Sweden, below normal in Spitsbergen, and above normal in Switzerland.

The weather of March over the British Isles was variable, generally temperature was below normal in the south-east but above normal in the north and west, while rainfall was above normal except in eastern Scotland and eastern England and sunshine below normal except in southern England and southern Ireland. The drought which was so marked a feature of the weather of February persisted generally during the first few days of March.* The 1st was a sunny day with over 9 hrs. of bright sunshine at several places, 9·5 hrs. at Dumfries and Armagh, while the 2nd was sunny in the south-east. Temperature was low in the east on these days, but rose somewhat by the 4th and 5th as a deep depression which had been centred over Iceland moved in an east-south-east direction and rain fell in Scotland and Ireland on the 4th. In the rear of this depression squally north-west winds prevailed with local hail, sleet and snow in the north on the 5th, 6th and 7th. Rain fell generally in the south on the 8th as a secondary disturbance moved rapidly from northern Ireland and intensified over the southern North Sea, 0·62in. fell at Collumpton, and 0·60in. at Jersey. On the 9th the cold weather of the north spread south and snow and sleet were reported from most parts on the 9th-11th, even as far south as Falmouth and Margate on the 10th and 11th. By the 12th an anticyclone had spread across the British Isles from Iceland and a period of dry anticyclonic weather prevailed until about the 20th. Some good sunshine records were obtained during this spell, 10·8 hrs. at Jersey on the 14th and 15th and at Hastings on the 16th and 10·6 hrs. at Portsmouth on the 13th and Hastings on the 14th. Day temperatures were high, except in the south-east, reaching 60°F. at Valentia on the 15th, but night temperatures continued low, 18°F. in the screen at Marlborough on the 13th. A trough of low pressure bringing rain generally crossed the British Isles on the 20th-22nd, but it did not displace the Scandinavian anticyclone, which dominated the weather over most of England on the 24th and 25th, these days being dry and sunny with cold south-easterly winds; 11·0 hrs. of bright sunshine occurred at Margate on the 25th and 10·8 hrs. at Clacton on the 24th. By the 26th, Easter Saturday, however, secondaries moving round a new Atlantic depression caused a renewal of unsettled weather with long periods of bright sunshine, but heavy rain in the west; 2·20in. were measured at Snowdon (Carnarvon), and 1·85in. at Borrowdale, Cumberland, on the 29th. Thunderstorms ocurred locally in the south and Midlands on the 30th and 31st. By the 31st cold northerly winds were spreading across the country in the rear of this depression and slight snow was reported from north Scotland. The distribution of bright sunshine for the month was as follows:—

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* See page 67.

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	75	—30	Liverpool	104	— 4
Aberdeen	72	—45	Ross-on-Wye	141	+25
Dublin	95	—28	Falmouth	150	+12
Birr Castle	134	+24	Gorleston	131	— 4
Valentia	136	+13	Kew	121	+16

The special message from Brazil states that the rainfall in the northern and central regions was scarce with 3·22in. and 2·40in. below normal respectively, and irregular in the southern regions with 0·24in. below normal. The crops generally were in good condition. Seven anticyclones passed across the country. At Rio de Janeiro pressure was 0·6mb. above normal and temperature 0·9°F. abve normal.

Miscellaneous notes on weather abroad culled from various sources.

Heavy snowstorms occurred over the Black Sea and Sea of

Marmora during the 1st and 2nd. Rain fell on the 9th in the low regions of Switzerland, breaking the drought which had prevailed there for some time. In the mountains the snowfalls on the 7th-9th were the heaviest of the winter, and from 2-4ft. of snow fell about the 13th. Over 700 men and 100 horses were adrift between the 8th and 10th on large icefloes detached by strong winds from the main icefield in the eastern parts of the Gulf of Finland. A blizzard occurred there on the 9th, but on the night of the 10th new ice was formed owing to the intense cold and nearly all were rescued on the 11th. Navigation closed at Helsinki on the 14th owing to the ice, and Memel harbour became blocked with ice on the 15th though this was drifting away by the 17th. Extensive floods occurred in the Kuban Basin and other regions of the northern Caucasus—more than 20,000 collective farms being flooded. Snowstorms occurred over the Black Sea on the 25th, but later the ice was breaking up in most of the rivers and harbours of south-eastern Europe. Three ice-breakers remained icebound between Novaya Zemlya and the mainland during most of the month (*The Times*, March 3rd-April 1st).

Stormy weather occurred round Melbourne on the 10th and a squall swept the various suburban seaside resorts near Adelaide on the 27th capsizing 22 yachts and drowning 5 people. A cyclone destroyed many houses in New Caledonia (Oceania) about the 8th and damaged a number of plantations (*The Times*, March 9th-28th).

Gales, snowstorms and bitter cold caused the death of 36 people along the Atlantic seaboard of the United States on the 6th and 7th. Tornadoes wrought havoc to life and property in Alabama, Georgia, Tennessee, South Carolina and Kentucky on the 21st and 22nd; 303 people were reported killed and 2,500 injured. Cold weather followed the storms. Nine people were also killed in a second series of storms over Alabama and western Georgia later the same week. Temperature was below normal during the first half of the month, being over 20°F. below normal at most places in the Gulf States and Ohio Valley in the week ending the 15th, but about normal later in the month. Rainfall was mainly above normal during the first week, below normal the second and about normal the rest of the month. Excessive rains were reported in the maize area of the Argentine (*The Times*, March 7th-29th, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin*).

Rainfall, March, 1932—General Distribution

England and Wales	88	per cent of the average 1881-1915.
Scotland	101	
Ireland	71	
British Isles	88	

Rainfall: March, 1932: England and Wales

Co.	STATION	In.	Per-cent of Av.	Co.	STATION	In.	Per-cent. of Av.
Lond	Camden Square	1·52	83	*Leics*	Belvoir Castle	1·68	93
Sur	Reigate, Alvington	1·48	63	*Rut*	Ridlington	1·62	93
Kent	Tenterden, Ashenden	1·52	71	*Linc*	Boston, Skirbeck	1·45	93
,,	Folkestone, Boro. San.	1·32	..	,,	Cranwell Aerodrome	1·49	106
,,	Margate, Cliftonville	·96	60	,,	Skegness, Marine Gdns	1·56	94
,,	Sevenoaks, Speldhurst	1·77	...	,,	Louth, Westgate	1·88	89
Sus	Patching Farm	1·33	62	,,	Brigg, Wrawby St.	1·52	...
,,	Brighton, Old Steyne	1·22	60	*Notts*	Worksop, Hodsock	1·06	63
,,	Heathfield, Barklye	1·85	74	*Derby*	Derby, L. M. & S. Rly.	1·47	86
Hants	Ventnor, Roy. Nat. Hos.	1·24	60	,,	Buxton, Devon Hos.	3·41	83
,,	Fordingbridge, Oaklnds	1·69	73	*Ches*	Runcorn, Weston Pt.	1·61	80
,,	Ovington Rectory	1·86	72	,,	Nantwich, Dorfold Hall	1·67	...
,,	Sherborne St. John	1·88	84	*Lancs*	Manchester, Whit. Pk.	1·81	80
Berks	Wellington College	1·49	75	,,	Stonyhurst College	3·07	83
,,	Newbury, Greenham	2·02	89	,,	Southport, Hesketh Pk	2·01	90
Herts	Welwyn Garden City	1·78	...	,,	Lancaster, Strathspey	2·88	...
Bucks	H. Wycombe, Flackwell	1·67	...	*Yorks*	Wath-upon-Dearne	1·37	79
Oxf	Oxford, Mag. College	1·76	115	,,	Bradford, Lister Pk.	2·03	83
Nor	Pitsford, Sedgebrook	1·52	86	,,	Oughtershaw Hall	4·58	...
,,	Oundle	1·26	...	,,	Wetherby, Ribston H.	1·85	95
Beds	Woburn, Crawley Mill	1·46	85	,,	Hull, Pearson Park	1·71	94
Cam	Cambridge, Bot. Gdns.	1·36	92	,,	Holme-on-Spalding	1·82	...
Essex	Chelmsford, County Lab	1·10	64	,,	West Witton, Ivy Ho.	2·29	74
,,	Lexden Hill House	1·14	...	,,	Felixkirk, Mt. St. John	2·15	109
Suff	Haughley House	1·40	...	,,	Pickering, Hungate	2·10	105
,,	Campsea Ashe	1·70	101	,,	Scarborough	2·02	112
Norf	Norwich, Eaton	...	...	,,	Middlesbrough	2·17	138
,,	Wells, Holkham Hall	1·29	79	,,	Baldersdale, Hury Res.	2·29	...
,,	Swaffham, The Villa	1·47	80	*Durh*	Ushaw College	2·53	115
Wilts	Devizes, Highclere	2·42	115	*Nor*	Newcastle, Town Moor	1·57	74
,,	Bishops Cannings	2·23	99	,,	Bellingham. Highgreen	2·69	91
Dor	Evershot, Melbury Ho.	2·76	93	,,	Lilburn Tower Gdns.	2·71	102
,,	Creech Grange	2·22	79	*Cumb*	Geltsdale	3·59	...
,,	Shaftesbury, Abbey Ho.	1·76	75	,,	Carlisle, Scaleby Hall	3·20	131
Devon	Plymouth, The Hoe	2·10	72	,,	Borrowdale, Seathwaite	9·90	94
,,	Launceston, Werringt'n	2·18	...	,,	Borrowdale, Moraine	6·32	...
,,	Holne, Church Pk. Cott.	5·06	94	,,	Keswick, High Hill	3·51	...
,,	Cullompton	2·60	95	*West*	Appleby, Castle Bank	2·85	106
,,	Sidmouth, Sidmount	2·46	101	*Glam*	Cardiff, Ely P. Stn.	1·87	58
,,	Filleigh, Castle Hill	2·72	...	,,	Treherbert, Tynywaun	5·53	...
,,	Barnstaple. N. Dev. Ath	2·27	87	*Carm*	Carmarthen Friary	2·69	71
,,	Dartm'r, Cranmere Pool	5·90	...	*Pemb*	Haverfordwest, School	2·28	67
Corn	Redruth, Trewirgie	2·60	72	*Card*	Aberystwyth	3·07	...
,,	Penzance, Morrab Gdn.	2·81	88	,,	Cardigan, County Sch.	2·88	...
,,	St. Austell, Trevarna	3·08	90	*Brec*	Crickhowell, Talymaes	3·00	...
Soms	Chewton Mendip	2·88	81	*Rad*	Birm W. W. Tyrmynydd	3·91	73
,,	Long Ashton	2·60	103	*Mont*	Lake Vyrnwy	4·72	110
,,	Street, Millfield	1·89	92	*Denb*	Llangynhafal	1·91	82
Glos.	Blockley	1·80	...	*Mer*	Dolgelly, Bryntirion	4·94	100
,,	Cirencester, Gwynfa	2·51	109	*Carn*	Llandudno	1·50	69
Here	Ross, Birchlea	1·87	92	,,	Snowdon, L. Llydaw 9	9·25	...
,,	Ledbury, Underdown	1·93	102	*Ang*	Holyhead, Salt Island	1·48	57
Salop	Church Stretton	3·43	145	,,	Lligwy	1·47	...
,,	Shifnal, Hatton Grange	1·71	93	*Isle of Man*			
Worc	Ombersley, Holt Lock	1·64	96		Douglas, Boro' Cem.	1·67	56
War	Birminghm, Edgbaston	1·89	99	*Guernsey*			
Leics	Thornton Reservoir	2·16	117		St. PeterP't. GrangeRd.	2·44	99

Rainfall : March, 1932 : Scotland and Ireland

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per cent. of Av.
Wigt	Pt. William, Monreith	2·78	97	*Suth*	Melvich	3·14	...
,,	New Luce School	3·67	104	,,	Loch More, Achfary	7·64	119
Kirk	Carsphairn, Shiel	4·22	70	*Caith*	Wick	2·05	90
Dumf	Dumfries, Crichton, R.I	2·96	...	*Ork*	Pomona, Deerness	3·19	113
,,	Eskdalemuir Obs.	4·19	86	*Shet*	Lerwick	3·35	107
Roxb	Branxholm	2·84	98	*Cork*	Caheragh Rectory	3·39	...
Selk	Ettrick Manse	2·85	56	,,	Dunmanway Rectory	3·67	75
Peeb	West Linton	3·20	...	,,	Ballinacurra	3·19	112
Berk	Marchmont House	3·17	120	,,	Glanmire, Lota Lo	3·21	103
Hadd	North Berwick Res.	2·38	127	*Kerry*	Valentia Obsy	3·84	85
Midl	Edinburgh, Roy. Obs.	2·64	134	,,	Gearahameen	5·60	...
Lan	Auchtyfardle	2·40	...	,,	Killarney Asylum	...	...
Ayr	Kilmarnock, Kay Pk.	2·79	...	,,	Darrynane Abbey	3·39	83
,,	Girvan, Pinmore	3·46	92	*Wat*	Waterford, Gortmore	2·19	81
Renf	Glasgow, Queen's Pk.	2·13	82	*Tip*	Nenagh, Cas. Lough	1·80	58
,,	Greenock, Prospect H.	2·42	49	,,	Roscrea, Timoney Park	1·32	...
Bute	Rothesay, Ardencraig.	3·10	86	,,	Cashel, Ballinamona	1·41	51
,,	Dougarie Lodge	2·89	...	*Lim*	Foynes, Coolnanes	2·15	73
Arg	Ardgour House	5·54	...	,,	Castleconnel Rec.	2·14	...
,,	Glen Etive	...	...	*Clare*	Inagh, Mount Callan	2.58	...
,,	Oban	3·10	73	,,	Broadford, Hurdlest'n.	2·06	...
,,	Poltalloch	4·43	116	*Wexf*	Gorey, Courtown Ho	1·88	89
,,	Inveraray Castle	4·87	77	*Kilk*	Kilkenny Castle	1·42	62
,,	Islay, Eallabus	4·17	109	*Wic*	Rathnew, Clonmannon	1·54	...
,,	Mull, Benmore	...	...	*Carl*	Hacketstown Rectory	1·89	67
,,	Tiree	...	...	*Leix*	Blandsfort House	1·44	55
Kinr	Loch Leven Sluice	2·44	82	,,	Mountmellick	1·69	...
Perth	Loch Dhu	3·60	55	*Off'ly*	Birr Castle	1·26	52
,,	Balquhidder, Stronvar	3·06	...	*Kild'r*	Monasterevin	1·28	...
,,	Crieff, Strathearn Hyd.	2·85	89	*Dubl*	Dublin, FitzWm. Sq.	1·23	63
,,	Blair Castle Gardens	2·71	103	,,	Balbriggan, Ardgillan.	1·25	62
Angus	Kettins School	2·44	111	*Me'th*	Beauparc, St. Cloud	1·26	...
,,	Dundee, E. Necropolis	2·59	126	,,	Kells, Headfort	1·61	59
,,	Pearsie House	3·00	...	*W.M*	Moate, Coolatore	1·08	...
,,	Montrose, Sunnyside	2·78	134	,,	Mullingar, Belvedere	1·46	54
Aber	Braemar, Bank	2·04	68	*Long*	Castle Forbes Gdns	1·83	62
,,	Logie Coldstone Sch.	...	...	*Gal*	Ballynahinch Castle	2·67	52
,,	Aberdeen, King's Coll.	4·15	172	,,	Galway, Grammar Sch.	1·63	...
,,	Fyvie Castle	3·88	143	*Mayo*	Mallaranny	3·00	...
Moray	Gordon Castle	2·74	118	,,	Westport House	2·55	65
,,	Grantown-on-Spey	3·42	129	,,	Delphi Lodge	4·81	58
Nairn	Nairn, Delnies	2·41	129	*Sligo*	Markree Obsy	2·28	67
Invs	Ben Alder Lodge	2·77	...	*Cav'n*	Belturbet, Cloverhill	2·10	76
,,	Kingussie, The Birches	2·18	...	*Ferm*	Enniskillen, Portora	2·40	...
,,	Loch Quoich, Loan	3·95	...	*Arm*	Armagh Obsy	1·82	77
,,	Glenquoich	5·00	51	*Down*	Fofanny Reservoir	4·59	...
,,	Inverness, Culduthel R.	2·39	...	,,	Seaforde	2·07	71
,,	Arisaig, Faire-na-Squir	2·49	...	,,	Donaghadee, C. Stn.	1·47	67
,,	Fort William, Glasdrum	3·30	...	,,	Banbridge, Milltown	1·89	...
,,	Skye, Dunvegan	3·17	...	*Antr*	Belfast, Cavehill Rd.	2·14	...
,,	Barra, Skallary	3·16	...	,,	Glenarm Castle	2·82	...
R & C	Alness Ardross Cas.	3·84	118	,,	Ballymena, Harryville	2·61	83
,,	Ullapool	3·20	77	*Lon*	Londonderry, Creggan	2·98	93
,,	Achnashellach	4·04	...	*Tyr*	Omagh, Edenfel	2·42	77
,,	Stornoway	2·95	...	*Don*	Malin Head	1·95	...
Suth	Lairg	3·18	103	,,	Dunfanaghy	2·34	...
,,	Tongue	4·11	122	,,	Killybegs, Rockmount	3·23	63

Climatological Table for the British Empire, October, 1931

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb							
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1021·5	+ 7·5	65	25	55·9	41·7	48·8	— 1·1	43·8	92	8·1	0·65	— 2·05	7	2·9	27
Gibraltar	1017·9	+ 0·7	83	46	74·1	60·6	67·3	+ 1·2	60·3	84	5·6	5·99	+ 2·68	6	..	..
Malta	1018·3	+ 2·3	85	56	73·2	63·3	68·3	— 2·6	62·7	77	5·2	4·63	+ 1·76	5	7·3	64
St. Helena	1016·9	+ 1·3	64	51	59·6	53·4	56·5	— 1·8	53·9	95	9·7	1·38	..	21	..	..
Sierra Leone	1014·0	+ 2·4	89	64	86·5	69·6	78·1	— 2·0	78·2	85	4·7	10·28	— 2·34	22	..	..
Lagos, Nigeria	1012·0	+ 0·3	89	71	85·4	75·1	80·3	+ 0·8	76·9	83	8·9	5·87	— 1·89	15	..	..
Kaduna, Nigeria	1012·9	— 0·4	95	62	91·7	66.2	78·9	+ 2·6	72·2	76	5·3	1·49	— 0·69	6	..	..
Zomba, Nyasaland	1010·0	— 0·9	93	58	88·6	65·0	76·8	+ 2·7	..	52	2·1	0·18	— 1·34	1	..	..
Salisbury, Rhodesia	1011·8	+ 0·3	92	52	85·0	60·5	72·7	+ 2·0	57·9	37	2·4	1·91	+ 0·78	3	9·2	74
Cape Town	1018·6	+ 1·2	87	48	69·0	53·1	61·1	— 0·1	55·2	74	5·1	2·15	+ 0·50	10	..	..
Johannesburg	1013·6	+ 0·6	87	37	74·1	52·6	63·3	+ 0·5	52·6	53	4·1	1·20	— 1·36	9	8·5	67
Mauritius	1019·2	+ 1·0	83	59	80·1	65·1	72·6	— 0·1	67·1	63	7·6	0·58	— 0·80	13	8·5	68
Calcutta, Alipore Obsy.	1009·4	0·0	95	72	87·2	76·2	81·7	+ 2·4	76·6	89	5·7	6·15	+ 1·25	10*	..	..
Bombay	1008·2	— 1·6	94	71	86·7	75·0	80·9	— 1·5	75·4	86	6·0	13·07	+ 11·40	15*	..	..
Madras	1008·2	— 0·7	95	72	90·9	76·5	83·7	+ 1·4	76·4	79	6·6	6·77	— 4·38	6*	..	..
Colombo, Ceylon	1010·8	+ 0·8	87	72	85·6	76·3	80·9	+ 0·4	77·5	78	6·2	7·03	— 6·33	16	8·0	67
Singapore	1009·9	+ 0·2	91	72	86·6	75·1	80·9	+ 0·2	77·1	80	7·8	9·21	+ 1·14	17	5·0	41
Hongkong	1014·5	+ 0·9	86	63	79·2	70·1	74·7	— 2·2	66·3	61	4·4	0·73	— 4·39	10	7·6	66
Sandakan	..	..	91	74	88·5	75·4	81·9	+ 0·5	77·6	82	..	9·13	— 1·20	12	..	..
Sydney, N.S.W.	1016·1	+ 1·3	90	45	70·5	53·6	62·1	— 1·5	57·6	61	3·6	0·89	— 1·96	10	9·1	71
Melbourne	1017·1	+ 2·3	85	39	66·1	47·0	56·5	— 1·2	50·8	56	7·3	0·83	— 1·80	10	5·6	43
Adelaide	1020·0	+ 4·0	94	41	70·4	49·3	59·9	— 2·1	52·0	45	7·0	0·49	— 1·24	6	8·5	66
Perth, W. Australia	1019·8	+ 3·0	92	40	72·8	53·7	63·3	+ 2·5	55·3	52	3·4	1·01	— 1·21	9	10·0	78
Coolgardie	1019·4	+ 4·3	97	38	77·2	48·6	62·9	— 0·8	53·2	47	4·2	0·38	— 0·28	3	..	..
Brisbane	1018·2	+ 2·0	90	49	77·8	57·7	67·7	— 2·1	60·8	52	4·4	0·57	— 2·01	6	9·3	73
Hobart, Tasmania	1010·0	— 0·3	81	39	61·4	45·6	53·5	— 0·6	46·7	54	6·5	3·64	+ 1·38	15	7·0	53
Wellington, N.Z.	1013·7	+ 0·6	65	39	59·6	47·1	53·3	— 1·1	50·8	73	6·2	2·80	— 1·28	9	7·3	55
Suva, Fiji	1013·5	+ 0·3	87	63	80·4	69·5	74·9	— 0·9	70·0	73	6·7	8·98	+ 0·69	19	5·1	41
Apia, Samoa	1011·0	— 0·5	88	67	85·5	72·8	79·1	+ 0·7	76·1	74	4·9	8·34	+ 1·96	10	7·3	59
Kingston, Jamaica	1011·3	— 0·2	91	69	87·0	73·2	80·1	— 0·4	72·6	88	4·7	6·04	— 1·42	12	4·3	36
Grenada, W.I.	1013·0	+ 2·2	88	71	85·8	73·0	79·4	— 0·7	73·6	77	7·4	16·86	+ 9·10	27	..	..
Toronto	1017·0	— 0·5	77	34	61·1	45·2	53·1	+ 4·5	46·8	85	5·1	1·99	— 0·58	13	5·6	50
Winnipeg	1013·5	— 1·4	84	29	57·2	38·8	48·0	+ 7·3	38·4	87	5·2	2·07	+ 0·70	8	4·6	43
St. John, N.B.	1013·9	— 1·9	71	34	56·8	43·3	50·1	+ 4·8	46·2	83	6·2	5·00	+ 0·46	13	3·9	35
Victoria, B.C.	1017·1	0·0	68	43	56·4	46·4	51·4	+ 1·1	48·8	87	6·5	1·77	— 0·80	10	4·9	45

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

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The Movement of Volcanic Dust over the Globe

By C. E. P. Brooks, D.Sc.

A violent volcanic eruption, accompanied by the emission of large quantities of ash, began in the Andes of South America on April 10th. From the descriptions in the press it appears that the volcanoes of Descabezado, Las Yeguas, Tinguirica, Quizapu and several others all about 36°S., emitted large quantities of dust and ashes, which fell steadily as far east as Buenos Aires and Montevideo, a distance of 800 miles. Shortly after the news of the eruption reached London, the question was widely asked, how soon would the veil of volcanic dust reach England, and what phenomena could be expected when it arrived. The following notes attempt to indicate the probable answers to these questions.

The greatest volcanic eruption which has been studied in detail is that of Krakatoa on August 26th-27th, 1883. Krakatoa is a volcanic island in the Sunda Strait between Java and Sumatra, in latitude 6°S., 105°E.; after remaining dormant for nearly two centuries it became active again about 1880, a series of minor outbursts culminating in a violent explosion which blew more than half the island to pieces. The volume of dust and ashes has been calculated as 16 cubic kilometres, and even before the great explosion the column of water vapour and dust was ejected to a height of between 27 and 33 Km.,

(98396) 107/27 1,075 5/32 M. & S. *Gp.303*

where it spread out laterally in a gigantic black cloud, completely hiding the sun in the neighbouring parts of Java and Sumatra. From this cloud a rain of dust and ashes fell over a considerable area in the Indian Ocean, extending about 1,500 miles to the west and 1,200 miles to the south, but only a short distance to the north and east. Beyond the limits of appreciable dust fall, a series of optical phenomena were observed, including blue, green or otherwise coloured suns and moons, brown coronæ round the sun ("Bishop's Ring") and vivid red and yellow sunsets and afterglows.

These phenomena were not seen immediately, however, but spread over the world in a more or less orderly manner, obviously following the distribution of the dust by the upper currents of the atmosphere. Immediately after the eruption, two main currents showed themselves. One series of optical phenomena travelled directly towards the north-north-east, reaching Japan by August 29th or 30th, the calculated speed being 39 m.p.h. The other, and vastly greater series of phenomena travelled directly westward near the equator. The first appearance of the blue suns, haze and sunset glows travelled at a speed of 81 to 84 m.p.h., but the main body of the haze, causing the most conspicuous phenomena, had a speed of only 72 to 76 m.p.h.. The equatorial Atlantic was reached about the end of August, and the sky glows continued until September 5th, after which there was an interval of nearly ten days before they recommenced. Evidently the main body of volcanic ash had passed over by the 5th, and during the interval it travelled completely round the globe before again reaching the equatorial Atlantic. The blue and green suns were seen for only a short period and only doubtfully outside the tropics. In the Pacific the interval between the first and second circuits was less definite, and evidently the dust cloud was rapidly elongating.

Isochrones of the spread of the main dust cloud and the vivid sunset glows are shown in fig. 1, which has been constructed from plates 35 and 36 of the official British description of the eruption.* The eruption began on August 26th; the isochrones marked August 31st and September 5th show the limits after five and ten days, and show the great rapidity of the westward movement. Apart from the branch over Japan there are only two departures from the almost straight course towards the west; a southward branch towards Mauritius and a northward one over Central America, both of which, as will appear later, correspond with well-marked lines of movement of cirrus cloud. There was in addition, however, a gradual spreading north and south over the whole tropical zone, shown by the average limits of twilight glows during the first and second circuits of the globe:

**Report of the Krakatoa Committee of the Royal Society.* London, 1888.

	Atlantic Ocean	*Pacific Ocean*
First circuit	13°30′N. 16°50′S.	22°N. 16°S.
Second circuit	About 24°N. About 36°S.	

The gradual extension northwards and southwards continued

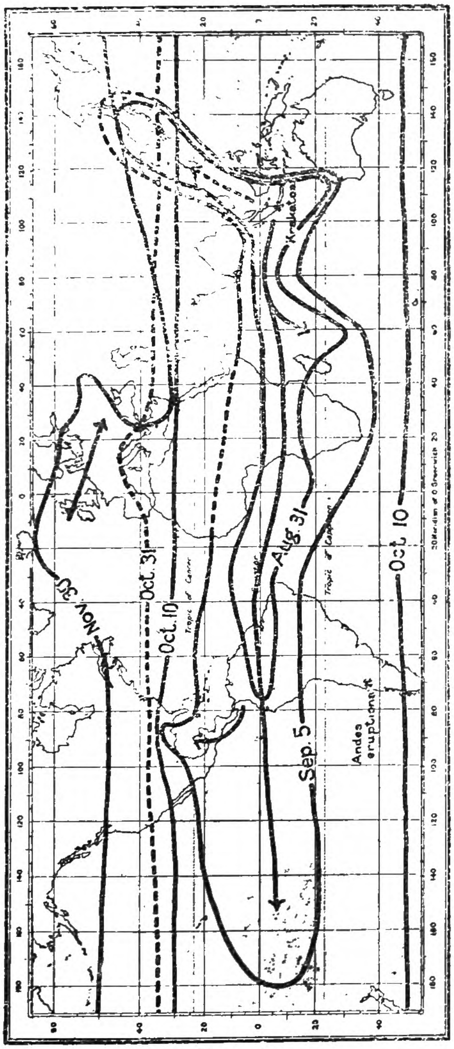
Krakatoa
Aug. 31
Sep. 5
Oct. 10
Oct. 10
Oct. 31
Nov. 30
Andes eruption
Tropic of Cancer
Tropic of Capricorn

FIG. 1.

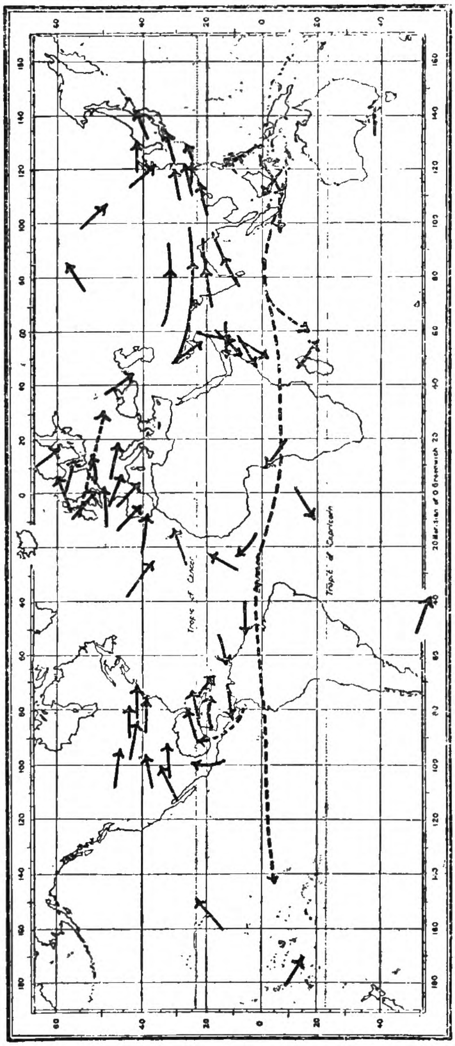
Tropic of Cancer
Tropic of Capricorn

FIG. 2.

until about the end of October, as shown by the limits for October 10th and 31st in fig. 1, but after October 5th the spread was very slow, and it appears that by the time the dust cloud reached latitude 30° " it no longer possessed that due east to west direction by which at first its general motion within the tropics was so markedly characterised. Beyond this limit the facts relating to the march of the glows over North America, Europe and northern Asia show that the current which brought the glow-causing material . . . . carried it more from west to east than from east to west " (Report, p. 431). Their subsequent spread is described as follows*:

" Up to about November 23rd glows seen north of about 32° to 36°N. [such as that reported in Surrey on November 9th] were for the most part detached or sporadic." The dust responsible for these mostly drifted up from between south and west. " But about November 23rd a very remarkable movement took place in such a manner that the direction in which the main stratum progressed is not clear, in spite of a large collection of dates. Western Canada, British Columbia, California, and north-west Iceland, seem to have been first affected, and then in succession England, Denmark, France, Italy, Germany, Spain, Algeria. Austria, Turkey, Russia, eastern Siberia, and northern China. To distinguish sporadic from continuous glows is no easy matter. But a general view inclines us to regard this latter movement as taking place from west to east. An exact course cannot be determined, owing to the inequality in density and irregularity of outline of the great cloud. Excluding occasional displays, the glows were seen in the north-western parts of Europe about a week before they drew attention in the east and south-east. England, as a whole, was affected before Denmark as a whole, Denmark before northern Russia, northern Russia before Kiachta. North Italy and Lisbon, parts of France and Germany were affected on the 26th, south-east Iceland and a large part of western and central Europe on the 27th, part of eastern Europe on the 28th, southern Italy and Greece about December 1st."

The Bishop's Ring phenomena, which depend for their occurrence on the presence of a large number of minute particles of approximately the same size, did not reach their maximum development until April, 1884, by which time the larger particles may be presumed to have been removed by gravity. They remained visible until the spring of 1886, and appeared again after the eruptions of Souffrière in St. Vincent and Mt. Pelée in Martinique in 1902.

The course followed by the dust clouds provides a great deal of information about the movements of the air at high levels. The dust of August 26th reached a height of some

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*London. *Q.J.R. Meteor. Soc.*, 14, 1888, p. 304.

30 Km., and the far more violent explosion of the 27th presumably went much higher. Observations of the afterglow give for the upper or middle part of the cloud a height of 37 Km. in August and 20 Km. in January. We can, therefore, regard the continuous arrows in fig. 1 as showing the air movements at a height of between 20 and 30 Km.. The temporary stream of dust towards Japan in the early days of the spread probably resulted from an air current at a lower level.

Fig. 2*, which has been compiled for me by Miss T. M. Hunt, shows by full arrows the general movements of cirrus and cirro-stratus clouds during the months of October to December. The average height of these clouds ranges from about 8 to 11 Km., or less than half the height of the upper part of the dust-cloud. Nevertheless the agreement between the main lines of figs. 1 and 2 is very close. The broken arrows, which show the main lines of drift of the Krakatoa dust, are inserted for comparison. The drifts of meteor trails, which occur at a still greater height, have no prevailing direction over Europe.

No other volcanic eruption of recent times has been followed by phenomena on anything like the same scale as that of Krakatoa. After the eruption of Katmai in Alaska on June 6th and 7th, 1912, the sky had a milky appearance over a large part of the northern hemisphere, and the power of the sun's rays was lowered appreciably, but there were no marked sunset phenomena. Evidence of the dust reached Algeria by June 19th and California by June 21st, but the data are insufficient to determine the movements of the dust cloud. No details seem to be available of the spread of the dust cloud from the West Indies in 1902, or of any remarkable sunset phenomena. Full details of the Andine eruption are not yet available, but their explosive violence does not seem to have been comparable with that of Krakatoa, and it is unlikely that the dust penetrated to such great heights in the atmosphere. It is to be expected that a milky sky, Bishop's Ring, and possibly sunset glows will travel eastward round the world in the southern hemisphere, but whether the British Isles will be affected is quite a different matter. The Krakatoa dust penetrated very slowly across the sub-tropical belts about latitude 30°. The Andine dust, starting in 36°S., would have to pass both these barriers as well as the equator itself, so that by the time it reaches our latitudes several months will have elapsed and the mass will have become very attenuated. Katmai does not seem to have affected the southern hemisphere appreciably, and if, as seems likely, the recent Andine eruption was on a similar scale to that of Katmai, it is unlikely to affect the northern hemisphere, though this should not prevent a careful watch from being kept.

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*Compiled mainly from :

SHAW, SIR NAPIER. *Manual of Meteorology*. Vol. II, Cambridge, 1928.

BEMMELEN, W. VAN. The antitrades. *Nature, London.* 109, 1922, pp. 172-3.

HILDEBRANDSSON, H. H. Rapport sur les observations internationales des nuages au Comité International Météorologique. Upsala, 1903.

H. C. BANERJEE and K. R. RAMANATHAN. Upper air conditions over India and its neighbourhood up to the cirrus level during the winter and the monsoon. *Poona, India Meteor. Dept., Sci. Notes,* 3, No. 21, 1930.

The Radiation Commission of the International Meteorological Committee and of the International Geodetic and Geophysical Union has issued the following circular :—

"In the middle of April there occurred in Argentina and Chile a series of violent volcanic outbreaks, which caused, according to descriptions given, a rich transfer of volcanic dust to the atmosphere.

With reference to the important results obtained through actinometric investigations in connexion with the great eruption of Mount Katmai in June, 1912, we take the liberty to draw your attention to the importance of detailed observations as regards the optical properties of the atmosphere at the present time, and beg you to join in favouring as much as possible the named researches.

We wish especially to recommend the following observations:

1. Actinometric observations as well of the total radiation from the sun, as of the radiation within selected parts of the spectrum.
2. Measurements of the diffused radiation from the sky.
3. Measurements of the atmospheric polarisation.
4. Measurements of the outgoing effective temperature radiation (nocturnal radiation).
5. Registrations with sunshine recorders.
6. Descriptions of the optical phenomena after sunset and before sunrise.

(Signed) J. Maurer, (Zürich) Linke, (Frankfurt) A. Ångström (Stockholm)."

The Splashing of Rain, with special reference to Evaporation Tanks

In an interesting article on "The Splashing of Rain" in the August, 1931, issue of this magazine, Lieut.-Col. E. Gold made some calculations of the height to which splashing might occur from a water surface. These calculations indicated that heights of the order of three or four feet might be reached; and in a note in this magazine for September, 1931, Mr. J. S. Dines gave an actual observation of splashing up to 2ft. 8in. It occurred to me that it would be very easy to obtain records in actual rainfall, from any desired surface, by means of a simple "splashmeter" constructed as shown in the sketch. This instrument is so easy to make and to use that I give particulars in the hope that some readers of this magazine may be sufficiently interested to take observations at their own stations. It consists of a sloping board (3½in. x ½in. material is suitable) supported on two uprights, one short and one long. It is important that a groove should be cut just inside each edge on the underside to prevent water creeping round from the top and vitiating the record. The underside is coated with coloured distemper, a material on which a splash of water makes a clear and permanent mark, and the edge or upper side is graduated to indicate the height of any point on the lower surface above ground. In the instrument which I have made the range of heights is from 3 to 17 inches, but it would be desirable to increase the maximum height to about 24 inches.

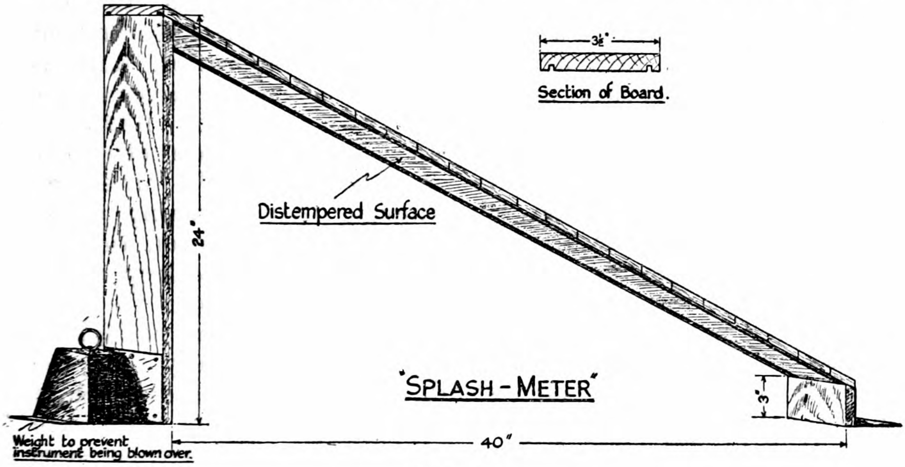

FIG. 1.

Before taking an observation the underside is freshly coated with distemper and allowed to dry. The instrument is then put out on the grass or other surface under investigation while rain is falling. Any drops splashing upwards will strike the distemper surface and discolour it. After a few minutes exposure the instrument is brought indoors. An examination of the distempered surface then clearly shows the height to which splashing has occurred.

Up to the time of writing I have made only two observations, both on the asphalt surface of the roof of the Meteorological Office, South Kensington. During the time of exposure the roof was thoroughly wet and the instrument stood in what was virtually an extended shallow puddle. On the first occasion (March 22nd) in rain falling at the rate of 4 mm. per hour, splashing up to 13 inches occurred. On the second occasion (March 23rd) in a heavier rain (at a rate of about 10 mm. per hour) one or two splashes reached 17 inches and there were numerous splashes up to 15 inches. I intend making further measurements as opportunity offers and to extend the investigation to include surfaces such as gravel, sand and grass.

This question of splashing is an important one in relation to rainfall measurements. It is of even more importance in connexion with the measurement of evaporation from a tank. To get a figure for the evaporation on a day when rain has fallen, the depth of rainfall as measured in an adjacent gauge is subtracted from the water level in the tank. This corrected level, when subtracted from the level read on the previous day, gives the value logged as evaporation. We assume, in fact, that the tank, acting as a rain-gauge, retains exactly the amount measured in an ordinary gauge. The evaporation tank is usually 6 feet square and its lip is about 3 inches above ground level. As a collector of rain it seems likely to be extremely efficient, but its open water surface obviously provides an ideal medium for out-splashing. We have seen that there is good reason for believing that splashing up to substantial heights occurs from a water surface, even in rain of moderate intensity. Consider for a moment a drop which splashes to a vertical height of 12 inches. Consider the drop simply as a projectile acted upon by gravity; the time of flight is 0.5 sec. If a wind of 12ft./sec. is blowing horizontally along the tank the drop, if sufficiently small, will be carried a distance of 6 feet before striking the water again. If the water were flush with the rim of the tank it is clear that no drop which splashed as high as 12 inches could fall back again into the water. Similarly it can be shown that there would be a loss of 70 per cent. of drops which reached 6 inches and of 50 per cent. of drops which reached 3 inches. In practice the water level is usually about 3 inches below the rim of the tank. We must, therefore, add three inches to all heights. A wind of 12 feet per second a few inches above the water corresponds with a wind of Beaufort force 5 or 6 as ordinarily estimated. It seems clear that in a strong wind there must be a very serious loss due to outsplashing when the tank is in an exposed situation. Unless this loss is balanced by insplashing (which is unlikely unless the tank is surrounded by some such surface as concrete or asphalt) the result would be an excessive figure for the "evaporation" on windy days with rain. This theory accords with some actual observations at Valentia Observatory which will, it is hoped, form the subject of a paper in *British Rainfall*, 1931.

E. G. BILHAM.

A Note on west-moving Depressions and on Cirrus Cloud Motion

This note is based on an examination of depressions which moved from some direction between south-east and north-east inclusive, which made a total westward progress of at least 400 miles (resolved towards due west), and which had closed centres passing over or near some part of the British Isles. In the last ten years only fourteen systems fulfilled those conditions. Eight of these had warm sectors on their right-hand sides during most of their motion, and moved in the same direction as the upper current. The remainder were surrounded with polar air, and had the strongest winds on their right-hand sides, so that they may be regarded as having travelled in the general current. In these cases the horizontal temperature gradients appeared to be small, so that there was probably no great change of wind with height. There are strong grounds for supposing that an easterly (or any other) wind current must be of the order of 15,000 feet or more in depth in order to carry along a disturbance. In a current only some 6,000 feet deep one can only detect very small irregularities travelling along the isobars, and then only for short distances.

The depressions with warm sectors are the most interesting, as they illustrate the importance of the temperature distribution for abnormal as well as for normal movements. They moved north-west or occasionally west, with warm sectors on their right-hand sides, consisting of continental air. In the region from England to central Europe they are commonest in the early summer, but round the Baltic they are more frequent later in the summer, when northern Europe is warm. They usually bring considerable rainfall, and frequently also thunder on the continent. On only one of the occasions in question did thunder extend to England, but if unclosed secondaries had been included there would have been several cases. The rain was preceded by high and then medium clouds moving from east or south-east, over a northerly current in the lower levels. Warm continental air has often enough moisture in it for heavy rainfall, provided that it can ascend far enough. Evaporation over land is likely to be an important source of moisture, since the mountains of southern Europe would remove much of any moisture brought from the Mediterrranean. Nevertheless a study of the air currents sometimes seems to indicate the Mediterranean as a source of moisture bringing rain (or snow) to England, not necessarily with a definite depression. If there is convergence in the circulation, the air may be moist even after it has crossed mountains. On the north side of the Alps there is sometimes slight rain or snow with a southerly upper current (part of a general southerly current), and the falling precipitation keeps the lower air damp, as is shown by the irregular masses of nimbus cloud, often joined in places to the alto-stratus above.

In the eight cases with warm sectors, observations of cirrus cloud motion were made either over or at the edges of the depressions, and the direction of motion of the cirrus and of the depressions agreed well, the difference not exceeding 30° and sometimes being within 10°. A larger number of observations is available for depressions moving northward from France, and these also show good agreement. The cirrus velocity is usually greater than that of the depression, whether directed towards west or north, and probably the middle layers of the troposphere are really the most important.

These continental depressions are warm and therefore shallow in the true three-dimensional sense, and not only in the fictitious sense in which the word is normally used. If a depression has a cold centre it extends to the cirrus level, so that the cirrus cloud motion at a particular place depends partly on the rotation round the centre, and not only on the motion of the system as a whole. In a depression with a warm sector there is better agreement, but a disturbing influence may arise from the presence of a wedge of high pressure at cirrus levels over the warm sector, especially in winter. For example there may be rapid cirrus motion from north-west in front of a depression moving north-east. The statistics given by Pick and Bowering* show that in 137 out of 162 cases, or 85 per cent., the angle between the cirrus motion and the motion of the depression did not exceed 90°. This is, of course, due to the general eastward motion, but a study of the abnormal tracks shows that the relation is real and not a mere coincidence. Attention may also be drawn to a recent note by Ramanathan and Ramakrishnan†, who show that Indian monsoon depressions move west or north-west in agreement with the upper winds, and with the observed gradients of temperature and pressure in the upper troposphere.

There may be some difference of opinion as to whether the upper wind or the closely related temperature distribution is the more fundamental. If we regard radiation as the primary factor, then the temperature is of outstanding importance, and in the case of the west-moving depressions one of the original causes is the heating of the continental air. As regards the short-period changes, the adjustments between temperature, pressure, and wind are mutual, and no one factor can be regarded as the cause of the others. Progress would seem to depend on the simultaneous handling of all three variables. There appears to be little chance of any accurate mapping of upper

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***London, Q.J.R. Meteor. Soc.* 57, p. 274.

†*Nature, London,* 129, p. 615.

winds over bad weather areas, but there remains the possibility of making progress from a knowledge of the distribution of pressure and temperature, together with a rough knowledge of the winds, and of the vertical motion deduced from the rainfall.

C. K. M. DOUGLAS.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, April 20th, at 49, Cromwell Road, South Kensington, Prof. S. Chapman, F.R.S., President, in the Chair.

J. N. L. Baker, Lecturer in Geography, Oxford.—The Climate of England in the Seventeenth Century.

The paper deals with three classes of evidence for climatic conditions in England during the century. A large number of descriptive writings provide evidence of a somewhat inconclusive character, and this can be supplemented by the reports of the Venetian Ambassadors, published in the Calendars of Domestic State Papers (Venetian) and elsewhere. The Calendars of Domestic State Papers furnish many scattered references, both to short periods and to long spells of weather, and from these a continuous account can sometimes be constructed. They also include important tables of winds covering the periods 1667-72 and 1675-78. The MS. diaries preserved in the Bodleian Library are also of value. That of Dr. Napier covers the period 1598-1635, but is very fragmentary: that of Elias Ashmole only extends from 1677 to 1685, but is unusually full. Most of this evidence has not previously been used and an attempt is here made to correlate it with the accepted rainfall figures of Townley and Derham and other records, such as the diaries of Evelyn and Pepys. It is shown that in a number of cases the older evidence is unreliable. At the same time it is pointed out that all the evidence is of an unscientific nature and that strict comparison with reliable evidence of modern times is apt to lead to erroneous conclusions.

C. W. G. Daking, B.Sc.—The Meteorology of Kamaran Island (Red Sea).

This paper deals with the outstanding features of the meteorology of a district in which observations have only been taken comparatively recently; but nevertheless some interesting facts have been brought to light, especially with regard to the upper winds, of which so little was known. The paper includes a climatological table giving averages for all elements over a period of several years. In most respects results show that the climate experienced there is typically tropical, but it is noteworthy that for so small an island the conditions are as trying as those experienced inland on the continents of Africa and Asia.

D. Brunt, M.A., B.Sc.—Notes on Radiation in the Atmosphere.

The absorption spectra of water vapour and liquid water are discussed and compared, and the results shown for liquid water are applied to consider the justification for regarding cloud sheets and fog as black body radiators. Various series of observations of long wave radiation from the atmosphere are shown to fit very closely a formula only involving the absolute temperature and the vapour pressure. It is shown that the fall of temperature after sunset on clear nights is closely proportional to the square root of the time from sunset. The effects of absorption and radiation at the upper and lower levels of cloud sheets are discussed, and it is found that the tendency to instability is greatest for clouds of medium height.

Correspondence

To the Editor, *The Meteorological Magazine.*

A record Dry Winter at Guernsey

Rainfall records kept at Les Blanches, St. Martin's, Guernsey, since 1894, show that the "winter" six months just come to an end—that is the period from October, 1931, to March, 1932—has been the driest of the 38 winters covered by the observations.

There is nothing outstanding in the temperature record, which shows the season to have been one of average mildness. In the matter of rainfall, however, pronounced droughty conditions set in in the second week of September, at which time and as a result of excessive rains in July, August and the early days of September, a surplus of 8 inches was accumulated. This excess rainfall was steadily reduced in October, November and December when, normally, precipitation is heaviest in the island and it disappeared on Christmas Eve. The drought continued far into the New Year—in fact till towards the end of March, when temporarily or otherwise a break occurred.

In the table appended the statistics relate to the period, October-March, and give (1) the average mean temperature, rainfall and number of rain days of the 30 years, 1894-1923; (2) the figures of the past winter (the driest on record), which shows a rainfall deficit of 10.41 in.; and (3 and 4) the two previous driest winter of the 38 years.

	Mean temp. °F.	*Total rain* in.	*Rain Days*
Average (1894-1923) ...	46.4	21.45	121.7
Winter 1931-2 ...	46.8	11.04	78
,, 1897-8 ...	47.1	12.56	99
,, 1920-1 ...	47.9	12.96	97

From September 6th to March 19th, a period of 28 weeks, six of which were rainless—absolute droughts were registered in

October (19 days) and in February (16 days)—an excess rainfall was recorded in three weeks only, viz., those ended November 14th, January 9th and March 12th.

Associating as one does a generally low temperature with a dry winter it seems rather remarkable that in the three instances given of excessive drought each season was also distinctly mild.

BASIL T. ROWSWELL.

Les Blanches, Guernsey. April 9th, 1932.

Heavy Snow in April

An interesting example of a small local storm with very heavy precipitation in the form of snow and sleet occurred here on Monday, April 4th. During the early hours with a rising barometer, wind NW., moderate snow and sleet began to fall and continued until 1 p.m. Between 9 and 12 a.m. the fall of snow was very heavy, the flakes of snow being exceptionally large.

At this level, 486ft., about 3in. of heavy wet snow lay on the ground, the total in the gauge measuring 1.06in. while on the surrounding hills at a level of 900 to 1,000ft. snow lay to the depth of 7 to 9in., at 1,500ft. about 12in., and on the Black Mountains above 1,500ft. 12 to 14in. or more. Lower down the Golden Valley at Vowchurch, 450ft., between 2 and 3in. snow were reported on the ground, the total in the gauge measuring 1.15in. at 9 a.m.; at Kentchurch, 210ft., 2¼in. snow on ground and in gauge 1.34in.

Hereford had a fall of 0.50in. and Wormbridge, between Hereford and Pontrilas, 0.85in. The heaviest precipitation seems to have been about the centre of the Black Mountain district.

This is the heaviest fall of snow experienced in this district during this or last winter.

ROBERT GRAY.

Oaklands, Dorstone, Herefordshire. April 16th, 1932.

A remarkable Cirrus Band

At 5h. 40m. G.M.T. on Sunday, March 20th, 1932, approximately half an hour before sunrise, I observed what appeared to me to be a definite and single band of cirrus stretching from due north to south in a complete semicircle. The band tapered slightly at each extremity and its width was estimated to be about 5°. It was of a brilliant pink colour and the glow gave rise to considerable abnormal illumination. This glow was especially bright near the northern end, but both extremities were brighter than the portion in the zenith. The cirrus band appeared quite thick and even dense in places and was not of the thin fibrous type usually associated with such bands.

Apart from the band the sky was clear but for 2/10ths of alto-cumulus lenticularis situated due east with its base about 2° above the horizon. Other conditions were as follows: temperature 35°F.; wind NW. 1 m.p.h.; average visibility three miles, but ground mist in valleys. Previous to the appearance of the band the sky had been cloudless for some hours.

When the sun rose at 6h. 10m. G.M.T. the band rapidly faded and was followed by the gradual appearance from north-north-west of a sheet of cirro-stratus.

The sketch shows the southern extremity of the " arc."

C. A. JUPP.

R.A.F. Station, Upper Heyford, Oxford. March 22nd, 1932.

Halo Phenomena, Armagh, April 27th, 1932

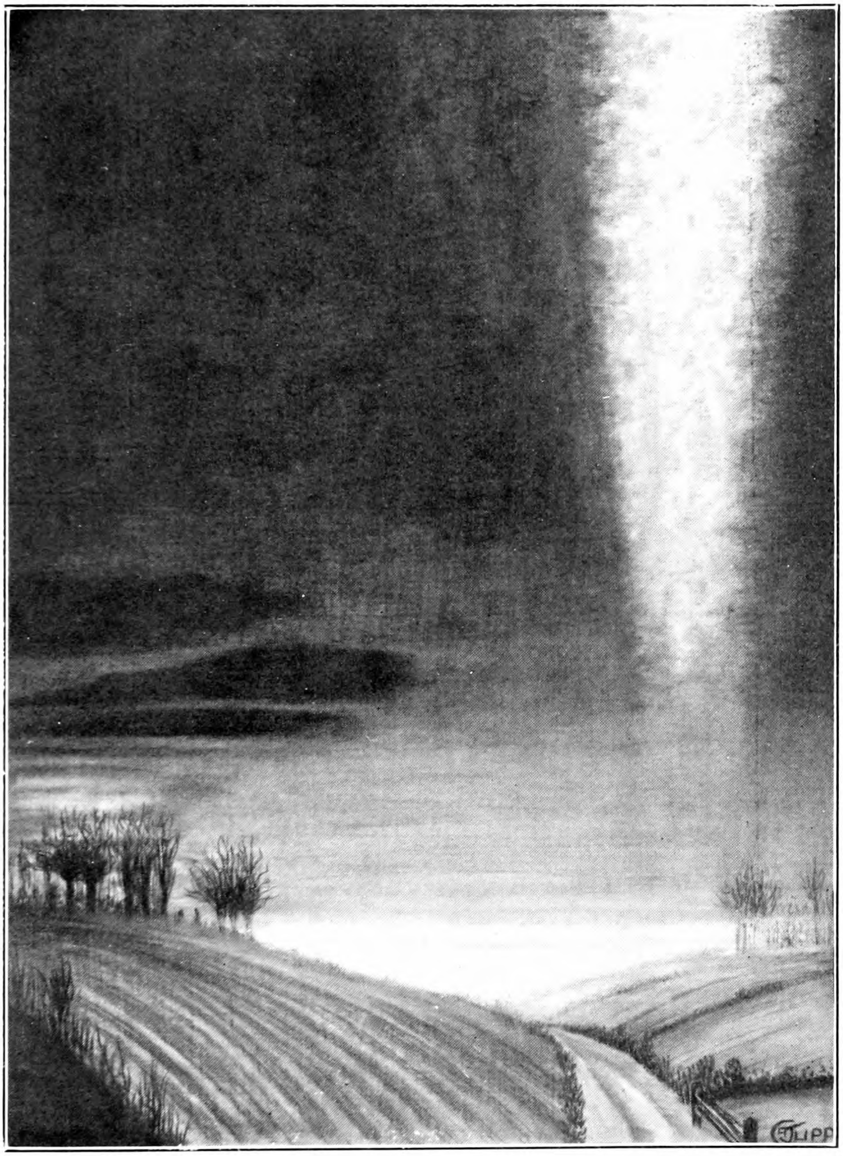
Rev. W. F. A. Ellison has forwarded a sketch of halo phenomena observed at Armagh between 9h. and 10h. on April 27th. The display included the halo of 22½° with parhelia, part of the mock-sun ring, the halo of 46° and traces of the upper arc of contact to the 46° halo which was described as very brilliant at the point of contact.

NOTES AND QUERIES

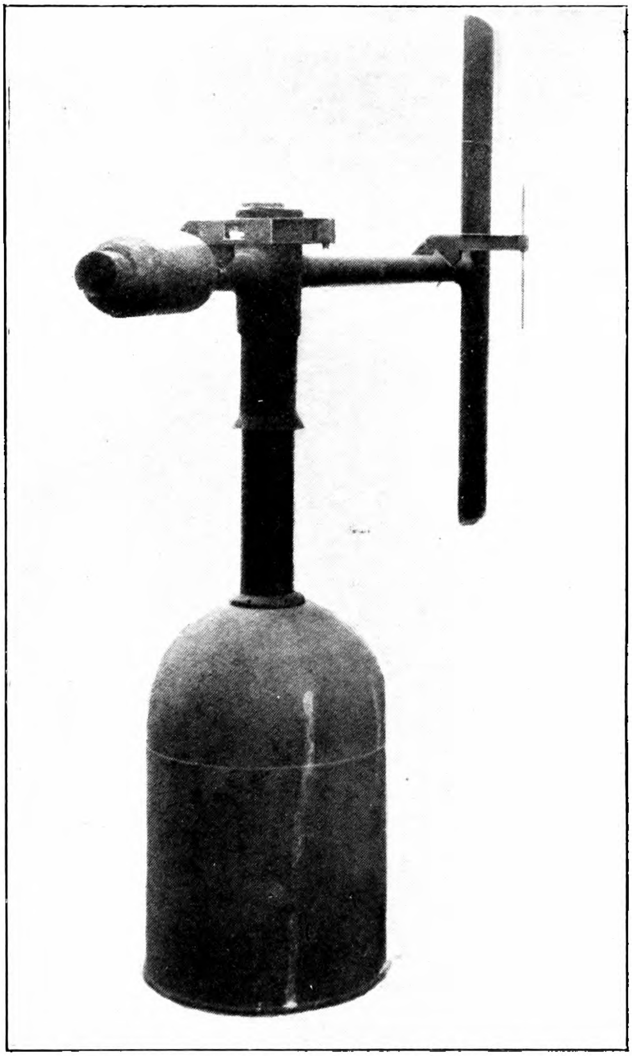
Sights for Anemometer Vane

A pair of sights has been constructed for use at Cardington to enable the anemometer to be orientated accurately. They have been found very convenient to use. Both sights are made of mahogany and have an inverted V seating at one end. This seating is faced with brass. A phosphor-bronze spring clip holds the seating securely to the horizontal tube of the vane. The foresight has at its further extremity a plug of brass with a small V-notch at top and bottom. This sight has also a spirit level, fitted so that when the bubble is central both the top and bottom surfaces of the projecting arm are horizontal. The backsight is similar in shape to the foresight but has no level, and in place of the V notches a vertical rod is held in a split bush.

To use the sights, the foresight is clipped to the horizontal part of the vane near the orifice and adjusted till the bubble is central. The backsight is similarly clipped on as far away from the foresight as convenient. Then looking across the top or bottom surfaces of the sights the backsight is adjusted till parallel with the foresight. The rod in the backsight is then



SOUTHERN EXTREMITY OF CIRRUS BAND, UPPER HEYFORD, MARCH 20TH, 1932.
(*Reproduced by the courtesy of Mr. C. A. Jupp*).



Sights for Anemometer Vane.

vertical and any part of it may be used in conjunction with the V notches to obtain a sight on a suitable object. The rod may be slid up or down as required. The sights may be used on either side of the vane.

A. Eric Mayers.

Maximum day Temperatures in early Spring

The lack of warm days during the first half of Spring, 1932, is shown in the following table covering data for this station for March and April during the past 19 years.

	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
No. of days with temperature 60° F or over in March and April	16	5	9	4	11	4	12	17	1	12
Highest maximum in March and April in °F.	74	72	76	64	71	69	67	74	67	69
Mean day maximum in April in °F.	61	55	58	52	52	54	56	60	52	55

	1924	1925	1926	1927	1928	1929	1930	1931	1932
No. of days with temperature 60° F. or over in March and April	10	3	12	10	12	20	7	9	1
Highest maximum in March and April in °F.	75	66	72	72	70	73	68	66	63
Mean day maximum in April in °F.	55	55	58	57	55	54	55	53	53

On the last day of the month when a maximum of 63°F. was recorded, April just retrieved its reputation for giving at least one day with a temperature above 60°F. The early spring of 1922 with a single maximum of 67°F. on April 14th is, however, only slightly better. The mean day maximum of 53°F. for April, 1932, is also no lower than that for April, 1931, and somewhat higher than those for 1917, 1918 and 1922.

W. H. Bigg.

Reviews

Wetter und Wetterentwicklung. By Dr. H. von Ficker. Size 7½ × 5in., pp. 140. *Illus.* Berlin, J. Springer, 1932.

This is an excellent little book. It is one of a series of elementary text-books, and illustrates the fact that the best popular work is written by a real master of the subject, provided that he has also the gift of simple exposition. The book is constructed on normal lines, and includes such questions as vertical stability and the effect of condensation. The last chapter contains a number of charts, most of which include the fronts, which are essential to an understanding of rainfall. Though fronts do not provide a complete explanation of rainfall, they are far more closely related to it than is the pressure distribution. They are now an indispensable part even of the most popular treatise, and though they involve a few additional technical terms, they present no special difficulties.

C. K. M. DOUGLAS.

Correlation between frost and the preceding meteorological conditions. By Barkat Ali and S. N. Naqvi. Calcutta, Indian Jour. Agric. Sci., 1, 1931, pp. 671-94.

In this useful study the authors follow the usual procedure of calculating relationships between the minimum temperature of the night on the one hand and the figures of dry- and wet-bulb temperatures and dew point on the preceding afternoon (at 16h.) on the other hand. The final results, obtained by partial correlation, are (for December and January):—

Minimum = ·392 (dew point) + ·116 (dry bulb) + 14·8; or
Minimum = ·837 (wet bulb) − ·130 (dry bulb) + 0·9.

These are based on 144 observations at Lahore and give a partial coefficient of ·73; the estimates of the minimum temperature have a probable error of about 1·7° F. Similar results are obtained for February.

On a few occasions the method fails, owing to the influx of air of a different character between the afternoon and the night, but the authors consider that these could be allowed for by a forecaster. Unfortunately, however, the numerical constants of the equations vary greatly with local conditions, and the necessary afternoon data are not yet available for calculating them for all districts in northern India.

The Annual Variation of Rainfall in New Zealand. By E. Kidson. New Zealand, J. Sci. Tech., Vol. XII, No. 5, pp. 268-72, Wellington, 1931.

It is shown that the distribution of the average annual rainfall amongst the months at stations in New Zealand is of three main types:—

(a) *The north and south-east of North Island and the north-east of South Island.*—Stations in these areas experience a pronounced maximum in winter. About 10·5 per cent. of the total rainfall falls in each of the three winter months, May, June and July, and rather less than 7 per cent. in January, November and December. The reason for this type of variation in the far north is that in summer the high pressure belt of sub-tropical regions approaches that area. The variation is similar to that experienced in the southern half of Australia, and it persists further south in New Zealand in the eastern districts protected by mountainous ranges to the west.

(b) *The south-east of South Island.*—The second type is, broadly speaking, the reverse of the first. The wettest month is December, with about 10 per cent., and the winter months May, June, July and August are usually dry with about 7·5 per cent. of the annual amount. Rain is brought to this region by south-westerly winds, which have their maximum frequency in December and which give little rain in the sheltered districts further to the north-east.

(c) *The central portion of North Island and the western half of South Island.*—In this type the wettest month is October with about 10 per cent. and the driest month February with about 6·5 per cent., but there is a subsidiary maximum in August. These areas are mountainous and the rainfall mainly orographical. The westerly winds are strongest in October and weakest in February, with a secondary maximum in autumn or winter and a secondary minimum in August. The low rainfall in February is associated with the time of least activity in the general circulation, temperature having ceased rising, but scarcely yet begun to fall.

J. Glasspoole.

The Occurrence of Thunderstorms in New Zealand. By E. Kidson and A. Thomson. New Zealand, J. Sci. Tech., Vol. XII, No. 4, pp. 193-206, Wellington, 1931.

The paper gives statistics and a map showing the distribution over New Zealand of the average number of thunderstorms per annum. There is a close relationship between this map and a map of the average annual rainfall.

The variation in the mean number of thunderstorms per year at selected stations has been correlated with the annual rainfall over New Zealand. The correlation coefficient is +0·42 for the 25 years 1905 to 1929. Conditions favourable to thunderstorm formation entail: (1) a high lapse rate, (2) a large amount of water vapour in these layers, and (3) absence of extensive sheets of high cloud. The conditions required are favourable for rain, but not rain of a general nature. This is the reason given for the small correlation between rainfall and thunderstorm frequency.

The average number of thunderstorm days in each month is also discussed. The variations from place to place are of particular interest in comparison with the variations in the incidence of rainfall throughout the year as shown in the previous paper.

J. Glasspoole.

Obituaries

Alfred Judson Henry.—Professor A. J. Henry was born at New Bethlehem, Pa., on September 1st, 1858, and died on October 5th, 1931, at the age of 73. After completing his education at the Columbian University in Washington he enlisted in 1878 in the meteorological section of the Signal Corps, U.S. Army. In his early work of observing and telegraphing he quickly won a reputation for reliability, and in 1883 was assigned to the Chief Signal Office in Washington. In 1888 the Central Office was given civilian status and Henry rose rapidly to the position of Principal Meteorologist, which he held until his death. He was for some time Official Forecaster at Washington, later in charge of Mount Weather Observatory, and finally Editor of the *Monthly Weather Review*, in which capacity he became well known to British meteorologists. His work was distinguished for the accurate and critical presentation of facts, and his "Climatology of the United States" is still a mine of reference. Among his books and papers may also be mentioned "Rainfall in the United States," "Weather forecasting from synoptic charts," "The floods of 1913 in the rivers of the Ohio and lower Mississippi Valley," "Upper air investigations at Mount Weather, Va.," "Forest and streamflow experiment at Wagon Wheel Gap, Colo," and "The Brückner cycle of climate oscillations in the United States," while he edited and wrote several chapters of the symposium on "Weather Forecasting in the United States." His wide knowledge was always at the service of his colleagues, and he has done much to encourage research among the younger meteorologists of the United States.

Louis Agricola Bauer.—The death of Dr. L. A. Bauer on April 12th, 1932, robs us of an outstanding figure in the study of terrestrial magnetism. Born in Cincinnati on January 26th, 1865, he was educated at the University of Cincinnati, where he received the degree of D.Sc. From 1887 to 1892 he served as astronomer and magnetic computer on the U.S. Coast and Geodetic Survey, and in 1895, after a period of study at the University of Berlin, where he received the Ph.D. for a thesis on the "Secular Variation of Terrestrial Magnetism" he became a teacher of mathematical physics in the University of Chicago. In 1897 he became assistant professor at Cincinnati, and in 1899 he was again appointed to the U.S. Coast Survey as Chief of the Terrestrial Magnetism Division, a post which he held until 1906. His activities were very numerous; he was Director of the Department of Terrestrial Magnetism from 1904 onwards, lecturer on terrestrial magnetism at Johns Hopkins University, and Editor of *Terrestrial Magnetism and Atmospheric Electricity* from its formation in 1896. He wrote numerous papers on his chosen subject and attended meetings in all parts of the world; in 1913 he delivered the Halley Lecture at Oxford on " The earth's magnetism." He was for eight years Secretary of the Section of Terrestrial Magnetism and Electricity of the International Union of Geodesy and Geophysics, and became President of the Section in 1927, succeeding the late Dr. C. Chree.

Guillaume Bigourdan—M. Bigourdan was born on April 6th, 1851, at Sistels. Although primarily an astronomer, Director of the Bureau International de l'Heure, and since 1904 a member of the Astronomical Section of the Paris Academy of Sciences, he was also keenly interested in meteorology. In 1915 he published a study of the distribution of cloudiness in France, and in 1916 a valuable book on the climate of France. He also wrote several papers on the propagation of sound in the atmosphere. He died on February 28th.

We regret to announce the death, on April 17th, 1932, of Mr. J. F. Davison, Grade III Clerk in the Meteorological Office. Mr. Davison entered the Office from the Royal Naval Air Service in January, 1920.

The Weather of April, 1932

Pressure was above normal over west and north-east Canada, most of the North Atlantic, Greenland, west Iceland, Spitsbergen, the Iberian Peninsula, south Italy and north Africa, the greatest excess being 11.2mb. at Julianehaab. Pressure was below normal over east Iceland and Europe, with the exception of the countries quoted above, the greatest deficit being 10.9mb. at Utsire. Temperature was above normal in Spitsbergen and northern Scandinavia and below normal from southern Scandinavia to the Iberian Peninsula. Rainfall was below normal at Spitsbergen but above normal in Sweden, where it was as much as 100 per cent. above normal round Lake Maelar.

Over the British Isles the weather of April was unsettled and cold, day temperatures being generally below normal until the last few days. Rain was frequent but usually not heavy in amount, though the totals for the month were mostly above normal. Sunshine also was deficient except in parts of Scotland and Ireland. The complex depression situated over the British Isles on the 1st drifted slowly south-east, causing precipitation generally and snow and sleet as far south as Birmingham and Ross-on-Wye from the 1st—4th. Another disturbance followed, moving south-east from north-west Iceland to southern Scandinavia, and there ensued a period of squally westerly winds and local gales accompanied by showers of snow, sleet, hail, rain, and local thunderstorms; snow was reported as far south as Oxford on the 7th. Much sun was experienced on the 4th—5th and 7th—8th, 11·7hrs. at Leuchars on the 7th, and 11·6hrs. at Torquay on the 5th. On the 8th the winds backed to SW. and the 9th was a mild day during this period of cold, 60°F. being reached at Cambridge and 59°F. in parts of Ireland. Yet another depression moved east across Great Britain causing heavy rain in north England and south Scotland on the 9th, 2·05in. at Borrowdale (Cumberland), and 1·49in. at Oughtershaw (Yorks.), and a renewal of strong winds and gales; Beaufort force 9 occurred at Lerwick on the 9th and Blacksod Point on the 10th. Snow was experienced over the country generally and extended this time south to Valentia, Waterford, Plymouth and Margate. A wedge of high pressure gave a brilliantly fine day on the 12th, 11·9hrs. at Scarboro', Southport and Chester, but weather deteriorated again in the west and north on the 13th at the approach of another Atlantic depression. Thunderstorms were experienced in the south and Midlands on the 12th and 14th. A change of type occurred about the 16th, when another wedge of high pressure passed south-east over the country. Bright sunny weather was enjoyed in Scotland and Ireland on the 16th—18th, 13·3hrs. at Malin Head on the 17th, but mainly dull, rainy conditions were experienced in south England. Unsettled weather was renewed in the north about the 19th and later throughout the country, as a depression off north-west Iceland moved slowly south-east. The weather for the ensuing week was showery, with local thunder and hail and some sleet or snow in Scotland, north England and the Midlands, but good sunshine records were also obtained, 13·4hrs. at Nairn on the 20th, 13·7hrs. at Renfrew on the 26th. On the 27th a depression approached the south-west coasts and remained almost stationary, while secondary disturbances moved round the main centre. Heavy rain fell locally on the 27th, 1·49in. at Fofanny (Co. Down). Conditions gradually became milder, and on the 30th 66°F. was registered at Greenwich and Woodhall Spa. Thunderstorms occurred locally in England and Ireland on the 29th and 30th, but generally they were fine sunny days. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	141	—13	Liverpool	131	—27
Aberdeen	147	—11	Ross-on-Wye	107	—43
Dublin	165	0	Falmouth	169	—15
Birr Castle	158	+ 4	Gorleston	139	—45
Valentia	154	— 6	Kew	117	—40

Miscellaneous notes on weather abroad culled from various sources.

Serious floods occurred in Roumania early in the month; about 50 people were drowned, and the damage was estimated at over £1,000,000. Sorokka in Bessarabia was for the most part destroyed. Heavy falls of snow were experienced in many parts of Spain at the beginning, and in Madrid it was intensely cold. "Mud-rain," which left on the ground slight traces of solid black material, fell at Florence, Genoa, and elsewhere in Italy on the 5th. The river ice was moving at Riga on the 9th, and navigation reopened at Helsingfors on the 11th. Falls of rain during the first half of the month considerably bettered the agricultural situation in Cyprus, which had become bad owing to drought. On account of the scarcity of snow during the early winter and its late melting due to the persistent cold, the level of the lakes in Switzerland was abnormally low, and there was a lack of electric power at the end of the month. (*The Times*, April 6th—30th.)

A tornado devastated the village of Majhirgati, near Khulna (Bengal), on the 26th, killing 4 people. Some 20 people were killed in a typhoon over the Philippines on the 30th. (*The Times*, May 3rd.)

A cyclone passed Port Louis (Mauritius) on the 10th but caused practically no damage. (*The Times*, April 12th.)

Warm weather was experienced in Manitoba during the early days of the month, but on the night of the 12th—13th a heavy snowstorm occurred in central Canada and floods were experienced in Quebec. Two feet of belated snow also fell in southern Alberta on the 21st. The total precipitation for the month was generally sufficient except in southern Saskatchewan. Seven people were reported to have been killed in Tennessee on the 25th by a tornado, which also swept over Arkansas and Alabama. Temperature was above normal over the United States generally, but fell below normal in the eastern States about the middle of the month. Rainfall was mainly below normal. (*The Times*, April 8th—26th, and *Washington D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Rainfall, April, 1932—General Distribution

England and Wales	156	per cent of the average 1881-1915.
Scotland	160	
Ireland	118	
British Isles	149	

Rainfall: April, 1932: England and Wales.

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Lond .	Camden Square	2·28	148	*Leics* .	Belvoir Castle...........	2·10	137
Sur .	Reigate, Alvington ...	2·37	142	*Rut* .	Ridlington	3·06	199
Kent .	Tenterden, Ashenden...	2·32	143	*Linc* .	Boston, Skirbeck	3·06	227
,, .	Folkestone, Boro. San .	3·47	...	,, .	Cranwell Aerodrome ...	1·86	141
,, .	Margate, Cliftonville...	1·50	111	,, .	Skegness, Marine Gdns	2·54	189
,, .	Sevenoaks, Speldhurst	2·71	...	,, .	Louth, Westgate	2·60	156
Sus .	Patching Farm	2·39	137	,, .	Brigg, Wrawby St. ...	2·44	...
,, .	Brighton, Old Steyne..	1·73	107	*Notts* .	Worksop, Hodsock ...	2·17	148
,, .	Heathfield, Barklye ...	3·02	163	*Derby* .	Derby, L. M. & S. Rly.	2·80	172
Hants .	Ventnor, Roy. Nat. Hos.	2·47	147	,, .	Buxton, Devon Hos. ...	5·44	185
,, .	Fordingbridge, Oaklnds	3·63	198	*Ches* .	Runcorn, Weston Pt...	3·02	175
,, .	Ovington Rectory	3·85	203	,, .	Nantwich, Dorfold Hall	3·32	...
,, .	Sherborne St. John ...	3·10	175	*Lancs* .	Manchester, Whit Pk.	2·93	153
Berks .	Wellington College ...	3·25	202	,, .	Stonyhurst College ...	3·80	140
,, .	Newbury, Greenham...	2·68	147	,, .	Southport, Hesketh Pk	2·77	150
Herts .	Welwyn Garden City...	2·55	...	,, .	Lancaster, Strathspey	3·05	...
Bucks .	H. Wycombe, Flackwell	2·62	...	*Yorks* .	Wath-upon-Dearne ...	2·29	145
Oxf .	Oxford, Mag. College...	1·99	129	,, .	Bradford, Lister Pk. ...	3·14	156
Nor .	Pitsford, Sedgebrook...	3·71	242	,, .	Oughtershaw Hall	6·12	...
,, .	Oundle....................	2·59	...	,, .	Wetherby, Ribston H.	2·45	139
Beds .	Woburn, Crawley Mill	2·21	147	,, .	Hull, Pearson Park ...	3·11	199
Cam .	Cambridge, Bot. Gdns.	2·24	165	,, .	Holme-on-Spalding ...	2·06	...
Essex .	Chelmsford, CountyLab	1·96	153	,, .	West Witton, Ivy Ho.	2·80	130
,, .	Lexden Hill House ...	2·13	...	,, .	Felixkirk, Mt. St. John	1·23	74
Suff .	Haughley House.........	1·94	...	,, .	Pickering, Hungate ...	1·88	113
,, .	Campsea Ashe...........	2·94	208	,, .	Scarborough	1·79	115
Norf .	Norwich, Eaton.........	...	...	,, .	Middlesbrough	·76	56
,, .	Wells, Holkham Hall	3·18	248	,, .	Balderdale, Hury Res.	4·43	...
,, .	Swaffham, The Villa...	3·66	239	*Durh* .	Ushaw College	1·85	98
Wilts .	Devizes, Highclere......	3·41	179	*Nor* .	Newcastle, Town Moor	1·06	65
,, .	Bishops Cannings	3·50	173	,, .	Bellingham, Highgreen	3·29	152
Dor .	Evershot, Melbury Ho.	3·43	145	,, .	Lilburn Tower Gdns...	2·18	110
,, .	Creech Grange	3·07	142	*Cumb* .	Geltsdale.................	3·04	...
,, .	Shaftesbury, Abbey Ho.	2·59	123	,, .	Carlisle, Scaleby Hall	2·64	135
Devon .	Plymouth, The Hoe...	3·22	142	,, .	Borrowdale, Seathwaite	11·25	163
,, .	Launceston, Werringt'n	3·28	...	,, .	Borrowdale, Moraine...	9·08	...
,, .	Holne, Church Pk. Cott.	5·99	165	,, .	Keswick, High Hill...	4·68	...
,, .	Cullompton..............	3·15	139	*West* .	Appleby, Castle Bank	3·15	162
,, .	Sidmouth, Sidmount...	...	...	*Glam* .	Cardiff, Ely P. Stn. ...	4·00	158
,, .	Filleigh, Castle Hill ...	2·38	...	,, .	Treherbert, Tynywaun	8·17	...
,, .	Barnstaple, N. Dev. Ath	2·00	94	*Carm* .	Carmarthen Friary ...	3·45	126
,, .	Dartm'r, Cranmere Pool	3·60	...	*Pemb* .	Haverfordwest, School	2·99	114
Corn .	Redruth, Trewirgie ...	2·90	101	*Card* .	Aberystwyth	2·27	...
,, .	Penzance, Morrab Gdn.	3·49	144	,, .	Cardigan, County Sch.	2·29	...
,, .	St. Austell, Trevarna...	3·99	141	*Brec* .	Crickhowell, Talymaes	5·60	...
Soms .	Chewton Mendip	4·58	154	*Rad* .	Birm W.W. Tyrmynydd	6·28	170
,, .	Long Ashton	3·56	163	*Mont* .	Lake Wyrnwy...........	7·43	246
,, .	Street, Millfield.........	2·49	124	*Denb* .	Llangynhafal	4·50	236
Glos .	Blockley	3·28	...	*Mer* .	Dolgelly, Bryntirion...	4·50	126
,, .	Cirencester, Gwynfa ...	2·94	157	*Carn* .	Llandudno	2·94	162
Here .	Ross, Birchlea...........	2·87	151	,, .	Snowdon, L. Llydaw 9	12·35	...
,, .	Ledbury, Underdown..	3·09	170	*Ang* .	Holyhead, Salt Island	...	...
Salop .	Church Stretton.........	5·07	235	,, .	Lligwy....................	3·23	...
,, .	Shifnal, Hatton Grange	3·46	206	*Isle of Man*			
Worc .	Ombersley, Holt Lock	3·37	222		Douglas, Boro' Cem. ...	3·78	153
War .	Birminghm, Edgbaston	3·24	186	*Guernsey*			
Leics .	Thornton Reservoir ...	3·39	199		St. PeterP't. Grange Rd.	2·94	146

Rainfall: April, 1932: Scotland and Ireland

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt	Pt. William, Monreith	2·65	120	*Suth*	Melvich	2·58	...
,,	New Luce School	5·23	197	,,	Loch More, Achfary	9·01	186
Kirk	Carsphairn, Shiel	7·35	177	*Caith*	Wick	2·97	149
Dumf	Dumfries, Crichton, R.I	2·54	...	*Ork*	Pomona, Deerness	3·41	164
,,	Eskdalemuir Obs.	5·30	156	*Shet*	Lerwick	4·16	182
Roxb	Branxholm	3·10	164	*Cork*	Caheragh Rectory	2·47	...
Selk	Ettrick Manse	5·38	154	,,	Dunmanway Rectory	3·31	80
Peeb	West Linton	3·89	...	,,	Ballinacurra	2·67	103
Berk	Marchmont House	2·29	113	,,	Glanmire, Lota Lo.	2·87	103
Hadd	North Berwick Res.	1·27	91	*Kerry*	Valentia Obsy	3·72	101
Midl	Edinburgh, Roy. Obs.	2·07	141	,,	Gearahameen	8·10	...
Lan	Auchtyfardle	3·03	...	,,	Killarney Asylum	4·30	130
Ayr	Kilmarnock, Kay Pk.	3·29	...	,,	Darrynane Abbey	3·15	91
,,	Girvan, Pinmore	3·49	117	*Wat*	Waterford, Gortmore	1·80	72
Renf	Glasgow, Queen's Pk.	3·20	163	*Tip*	Nenagh, Cas. Lough	2·74	109
,,	Greenock, Prospect H.	5·82	160	,,	Roscrea, Timoney Park	1·93	...
Bute	Rothesay, Ardencraig.	5·04	169	,,	Cashel, Ballinamona	2·52	101
,,	Dougarie Lodge	4·47	...	*Lim*	Foynes, Coolnanes	2·94	121
Arg	Ardgour House	7·37	...	,,	Castleconnel Rec.	2·83	...
,,	Glen Etive	8·01	144	*Clare*	Inagh, Mount Callan	4·19	...
,,	Oban	3·71	118	,,	Broadford, Hurdlest'n.	2·01	...
,,	Poltalloch	4·46	152	*Wexf*	Gorey, Courtown Ho.	3·10	141
,,	Inveraray Castle	8·13	177	*Kilk*	Kilkenny Castle	1·91	87
,,	Islay, Eallabus	...	...	*Wic*	Rathnew, Clonmannon	2·56	...
,,	Mull, Benmore	...	...	*Carl*	Hacketstown Rectory	3·27	123
,,	Tiree	3·41	...	*Leix*	Blandsfort House	3·27	125
Kinr	Loch Leven Sluice	2·35	125	,,	Moudtmellick	3·62	...
Perth	Loch Dhu	8·50	179	*Off'ly*	Birr Castle	2·22	103
,,	Balquhidder, Stronvar	4·55	...	*Kild'r.*	Monasterevin	...	...
,,	Crieff, Strathearn Hyd.	3·37	154	*Dubl*	Dublin, FitzWm. Sq.	2·43	128
,,	Blair Castle Gardens	3·73	177	,,	Balbriggan, Ardgillan.	2·29	116
Angus	Kettins School	3·49	210	*Me'th*	Beauparc, St. Cloud	2·46	...
,,	Dundee, E. Necropolis	2·22	131	,,	Kells, Headfort	2·38	95
,,	Pearsie House	3·01	...	*W.M*	Moate, Coolatore	2·03	...
,,	Montrose, Sunnyside	2·78	153	,,	Mullingar, Belvedere	2·69	113
Aber	Braemar, Bank	3·73	115	*Long*	Castle Forbes Gdns.	2·41	101
,,	Logie Coldstone Sch.	3·15	157	*Gal*	Ballynahinch Castle	3·82	108
,,	Aberdeen, King's Coll.	2·94	157	,,	Galway, Grammar Sch.	2·78	...
,,	Fyvie Castle	4·04	189	*Mayo*	Mallaranny	5·17	...
Moray	Gordon Castle	2·97	170	,,	Westport House	3·80	141
,,	Grantown-on-Spey	4·47	227	,,	Delphi Lodge	6·80	118
Nairn	Nairn, Delnies	3·13	209	*Sligo*	Markree Obsy	4·58	173
Inv's	Ben Alder Lodge	5·10	...	*Cav'n*	Belturbet, Cloverhill	2·65	115
,,	Kingussie, The Birches	3·58	...	*Ferm*	Enniskillen, Portora	2·55	...
,,	Loch Quoich, Loan	11·03	...	*Arm*	Armagh Obsy	2·38	113
,,	Glenquoich	9·72	150	*Down*	Fofanny Reservoir	5·22	...
,,	Inverness, Culduthel R.	3·29	...	,,	Seaforde	3·57	136
,,	Arisaig, Faire-na-Squir	3·69	...	,,	Donaghadee, C. Stn.	3·15	156
,,	Fort William, Glasdrum	5·90	...	,,	Banbridge, Milltown	2·35	...
,,	Skye, Dunvegan	5·90	...	*Antr*	Belfast, Cavehill Rd.	3·71	...
,,	Barra, Skallary	3·89	...	,,	Glenarm Castle	4·98	...
R & C	Alness Ardros Cas.	5·75	237	,,	Ballymena, Harryville	4·44	168
,,	Ullapool	5·02	162	*Lon*	Londonderry, Creggan	4·57	178
,,	Achnashellach	7·65	...	*Tyr*	Omagh, Edenfel	3·28	125
,,	Stornoway	3·87	...	*Don*	Malin Head	3·87	...
Suth	Lairg	4·10	177	,,	Dunfanaghy	4·18	...
,,	Tongue	4·23	161	,,	Killybegs, Rockmount.	3·15	87

Climatological Table for the British Empire, November, 1931

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Per-centage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1009·9	— 4·7	61	32	51·4	41·0	46·2	+ 2·2	43·7	92	8·5	2·14	— 0·08	15	2·0	22
Gibraltar	1018·6	+ 0·6	75	47	68·2	56·0	62·1	+ 1·6	55·9	86	6·1	3·82	— 2·57	11	..	..
Malta	1017·6	+ 1·7	74	54	68·4	59·7	64·1	+ 0·2	59·4	77	7·4	3·57	0·00	13	4·9	48
St. Helena	1014·3	— 0·2	68	52	61·1	54·3	57·7	— 1·9	55·4	94	9·8	1·84	..	17	..	..
Sierra Leone	1012·2	+ 1·3	89	67	87·1	70·4	78·7	— 2·5	77·9	84	5·5	5·05	— 0·07	13	..	..
Lagos, Nigeria	1009·9	— 0·9	89	72	86·7	76·1	81·4	0·0	77·3	82	8·5	2·24	— 0·34	14	..	..
Kaduna, Nigeria	1011·6	— 1·5	97	55	93·8	60·7	77·3	+ 1·1	66·8	54	4·5	1·64	+ 1·52	2	..	..
Zomba, Nyasaland	1008·8	— 0·1	94	60	83·5	65·3	74·4	— 1·2	..	69	6·3	6·10	+ 1·02	12	..	..
Salisbury, Rhodesia	1009·0	— 0·3	87	56	77·8	59·9	68·9	— 1·8	61·2	65	6·5	6·54	+ 2·94	14	5·6	43
Cape Town	1014·9	— 0·9	102	49	79·2	59·0	69·1	+ 4·7	60·8	64	3·3	0·13	— 0·96	3	..	..
Johannesburg	1012·4	+ 0·8	88	47	74·9	53·9	64·4	+ 0·7	57·0	68	5·2	4·62	— 0·34	15	7·7	57
Mauritius	1014·7	— 1·4	87	61	82·6	68·5	75·6	+ 0·1	71·2	68	7·7	3·82	+ 2·24	22	6·6	51
Calcutta, Alipore Obsy.	1013·9	+ 0·6	87	61	82·0	65·9	73·9	+ 0·4	67·4	91	2·9	5·04	+ 4·39	3*	..	..
Bombay	1011·3	— 0·7	94	71	90·3	74·2	82·3	+ 1·7	71·9	75	2·2	2·40	+ 1·95	2*	..	..
Madras	1011·7	+ 0·4	87	69	84·5	73·4	78·9	0·0	74·9	86	7·0	16·66	+ 3·05	16*	..	..
Colombo, Ceylon	1010·7	+ 0·7	87	71	85·6	73·5	79·5	— 0·5	76·3	80	5·7	15·74	+ 3·98	24	7·1	60
Singapore	..	..	92	71	87·4	73·6	80·5	— 0·1	76·1	79	7·3	10·48	+ 0·57	18	4·9	41
Hongkong	1016·4	— 1·1	82	56	76·0	66·1	71·1	+ 1·5	63·1	58	3·8	0·97	— 0·73	3	8·1	74
Sandakan	..	..	89	73	87·2	74·3	80·7	— 0·2	77·2	83	..	11·38	— 3·34	18	..	..
Sydney, N.S.W.	1015·3	+ 1·5	86	48	72·6	59·7	66·1	— 0·9	62·1	68	6·5	3·05	+ 0·20	15	8·1	58
Melbourne	1016·3	+ 1·9	91	43	69·7	50·7	60·2	— 1·1	55·0	61	7·6	3·93	+ 1·70	14	4·6	33
Adelaide	1016·9	+ 1·7	96	45	77·2	55·7	66·5	— 0·5	56·0	40	6·5	0·87	— 0·28	6	7·9	57
Perth, W. Australia	1017·3	+ 1·9	95	46	79·2	57·1	68·1	+ 2·0	58·2	44	3·0	0·03	— 0·77	2	10·7	77
Coolgardie	1016·4	+ 3·3	99	43	79·0	52·1	65·5	— 5·2	54·9	43	3·1	1·65	+ 1·06	6	..	..
Brisbane	1014·8	+ 0·2	89	58	80·2	64·3	72·3	— 1·2	66·6	65	7·0	8·51	+ 4·76	15	7·5	56
Hobart, Tasmania	1012·8	+ 3·2	77	39	63·2	47·6	55·4	— 1·8	49·6	58	7·7	2·85	+ 0·38	11	6·0	41
Wellington, N.Z.	1016·1	+ 4·0	70	37	62·9	51·6	57·3	+ 0·5	54·2	73	5·6	2·61	— 0·91	9	8·8	61
Suva, Fiji	1011·3	+ 0·2	88	69	83·9	72·5	78·2	+ 1·1	73·9	77	6·7	10·41	+ 0·62	24	6·0	46
Apia, Samoa	1009·1	— 0·4	88	70	86·1	72·5	79·3	+ 0·6	75·8	74	6·0	5·82	— 4·01	10	7·8	61
Kingston, Jamaica	1010·4	— 2·0	91	68	86·2	71·6	78·9	— 0·4	70·9	89	5·0	3·94	+ 0·91	8	2·9	26
Grenada, W.I.	1013·6	+ 3·0	90	72	88·0	74·6	81·3	+ 1·8	74·6	76	5·4	14·39	+ 5·93	30	..	..
Toronto	1019·0	+ 1·7	66	28	51·8	39·8	45·8	+ 8·8	40·8	84	7·5	2·38	— 0·25	11	2·5	26
Winnipeg	1014·8	— 2·6	66	—1	37·5	23·2	30·3	+ 9·0	..	..	5·8	0·35	— 0·72	3	3·6	40
St. John, N.B.	1019·0	+ 4·4	63	17	47·9	36·2	42·1	+ 5·4	37·4	83	6·3	1·56	— 2·85	15	3·7	39
Victoria, B.C.	1017·5	+ 1·6	56	31	46·5	38·6	42·5	— 2·0	39·8	84	6·3	5·28	— 0·13	15	3·7	40

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

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The Life Work of William Henry Dines

By E. G. BILHAM, B.Sc.

The death of W. H. Dines on Christmas Eve, 1927, represented a loss to science of more than ordinary magnitude. For more than thirty years he had been the most arresting figure in meteorology. He had enriched our instrumental resources with the products of his mechanical genius, opened up to us the new realm of the upper air, revolutionised our ideas of the thermal structure of the atmosphere and, in his latter years, set out to explore fresh fields in the domain of radiation. His fame was world-wide and our sorrow in his loss was shared wherever meteorology was studied.

It is the custom of mankind to perpetuate the memory of its great men, and it was natural that the Royal Meteorological Society should seek to perpetuate the memory of one of the greatest of its Fellows. Funds were collected, and in 1929 it was decided that the memorial to Dines should take the form of a volume of his collected papers. This volume is now in our hands, and surely no one who peruses it will question the wisdom of the Society's decision. To quote the words of the Preface:—" . . . it is a memorial built of materials selected and shaped by the prospector himself, and it represents his life as he made it, by enterprise and achievement. No granite pillar or marble block could bring other workers into such close contact with the spirit of research undertaken and accomplished.

(98721) 107/27 1,050 6/32 M. & S. *Gp.303*

and none could furnish a more inspiring incentive to further endeavour."

Here then is the life work of W. H. Dines between two covers. The work of the editing committee has been done well, and the format of the volume is worthy of the purpose it is intended to serve. The papers are arranged in four sections: I, Anemometry and Instrument Design, with an Introduction by Dr. Whipple. II, The Investigation of the Upper Air, with an Introduction by Mr. L. H. G. Dines. III, Radiation, with an Introduction by Lieut.-Col. Gold; and IV, Miscellaneous Papers, with an Introduction by Mr. R. G. K. Lempfert. Sir Richard Gregory has written the Preface and Sir Napier Shaw's obituary notice is reprinted from the *Proceedings of the Royal Society*. At the end of the volume there is a list of 92 papers, articles and letters not reproduced in the volume. To look at this list and at the four hundred pages of his work in the body of the volume is to realise, in some measure, the magnitude of Dines' output.

Section I contains the classical papers on wind pressure, and on the comparison of anemometers which Dines wrote as a member of the Wind Force Committee appointed by the Royal Meteorological Society in 1886. The paper on "Anemometer Comparisons," published by the Society in 1892, is of particular interest, for here in no more than four pages, half of them devoted to diagrams, is all that he ever wrote about his tube anemograph. The brevity of his remarks about this revolutionary instrument has, indeed, proved rather exasperating to his successors. He gives us, for instance, the relation $W = .000731\ V^2$ for the pressure difference W in inches of water set up by the head in a wind of V miles per hour, but does not tell us the value of the air density in which this relation is applicable. On the important question of the shaping of the float to give a linear velocity scale, he contents himself with saying that "the chamber N is not exactly conical, but bulges out slightly in the central parts." On the other hand we have, in another paper, very complete details about the liquid indicator which he devised for the purpose of obtaining eye readings of velocity, with the aid of a pressure head and vane. This instrument, though very simple and efficient, never obtained much popularity and is now practically unknown. The same remark applies to the helicoid anemometer, described by Dr. Whipple as perhaps the most ingenious of Dines' inventions.

We are indebted to Mr. J. Baxendell for a description of the float thermograph made by Halliwell for the Fernley Observatory, Southport. Though Dines did not design this particular instrument it incorporated the basic features of one which Dines had designed at Oxshott. In this instrument the thermometric substance is mercury, contained in a huge coil of narrow-bore copper tubing, sealed at one end and communicating at the other with a glass tube containing a float to which the recording pen is attached. For his original instrument Dines designed a very ingenious float which would move up and down the tube without sticking. This was the forerunner of the float of his float barograph, in which friction was eliminated even more satisfactorily by surrounding the float with steel balls.

In connexion with Dines' tilting rain-gauge, the descriptions and drawings of which are reproduced from the *Meteorological Magazine* (Vol. LV, 1920), there is an editorial note which concludes with the sentence "New types of gauge with reliable syphons have been produced in recent years and there is no scope for the ingenious tilting gauge." This is an unfortunate remark, because in my view the position is exactly the reverse. The design of a syphon to work with exact precision in open-air conditions, no matter how slowly the water (*dirty* water be it remembered) may rise in the ascending arm, presents almost insuperable difficulties and it cannot be said that designers have solved the problem. Dines knew all about this difficulty, and in his rain-gauge he arranged for the syphon to be started by the sudden tilting over of the whole receiver under the action of gravity, when 10 mm. of rain had been collected. By this device the action of the syphon was rendered uniform and positive in all conditions. After some years of experience with natural syphon gauges my view is that the Dines gauge is vastly superior even in the rather crude form in which it existed at Benson fifteen years ago.

Section II, on the Investigation of the Upper Air, occupies more than half the volume. It is a very pleasant experience to see these epoch-making papers bound together in orderly sequence and to be able to trace the development of Dines' ideas and methods from their beginning, when Dines, like almost everyone else, believed in the convectional theory of cyclones, to their maturity when the convectional theory had been disproved, and he had accumulated a mass of facts about the upper atmosphere which was, to quote *The Times*, "a matter for national congratulation." He began in 1901 with kites of the Hargreaves type and meteorographs made by Richard of Paris. From the outset he made his own kites and associated gear, and it is not long before we find him making his own meteorographs. By 1907 he had produced his balloon meteorograph and, in association with Mr. C. J. P. Cave, was beginning the great series of upper air soundings with which we are now so familiar. Dines' originality of outlook permeates all these papers from beginning to end. We may infer from his Presidential Address to the Society in 1902, printed in Section IV of the volume, that he was attracted to the idea of treating meteorological data by statistical methods based on the theory of probability, and it was appropriate that one who had accumulated so much new data by new methods should also employ new methods when the time came to analyse and discuss them. The results he obtained by means of the method of correlation are one of the outstanding achievements in meteorology and are too familiar to all of us to need further mention here.

In Section III, on Radiation, we find the same sequence of progress as in the first two sections, first some speculations and inferences from existing knowledge, next the design of new instruments, finally the presentation of important new knowledge gained from the new instruments. In this section the speculations are found in a paper on "The Heat Balance of the Atmosphere," presented to the Society in 1917. By constructing a sort of balance sheet for the earth and the atmosphere, he was able to make rough estimates of the radiation upwards and downwards from the atmosphere, the radiation from the earth reflected back again by the atmosphere, and so forth. In 1920 he constructed his radiometer for determining directly the long wave radiation and diffuse solar radiation from the sky. Between 1921 and 1927 the results obtained at Benson with this instrument were published regularly in the *Meteorological Magazine*. In the present volume they are gathered together and form a very valuable collection of data.

The last section contains miscellaneous papers not falling into the classification of the main sections. Here we find the description of his apparatus for demonstrating the formation of the tornado cloud, the papers in which he refuted the general belief that exceptionally cold periods are associated with high barometric pressure, his Presidential address on "The Element of Chance applied to Various Meteorological Problems," and a remarkable address on "Climate and its effect on the Average Length of Life," which he read before the Sanitary Institute in 1896. He maintained that high temperature was deleterious and low temperature beneficial to human health, and he practised what he preached in this connexion. I have vivid recollections of the complacency with which he regarded the conditions during the cold winter of 1916-7, when a temperature of − 4°F. was registered at Benson, and the barometer in the outbuilding where I worked was sometimes unreadable because the mercury in the attached thermometer had descended out of sight into the bulb.

It would be ungrateful to end this account of the Dines Memorial Volume without expressing admiration for the Sectional Introductions. These are really valuable additions to the book, pulling it together, so to speak, into a coherent whole. Quite obviously, a great deal of care and thought has gone to the making of the volume, and Dr. Brooks, who saw the volume through the press, is in particular to be congratulated on the success of the undertaking. The publication of the collected writings of a single worker has never previously been undertaken by the Royal Meteorological Society, and it is given to few men to merit such an honour. It will have served its purpose if it inspires us lesser mortals to imitate Dines' fixity of purpose, his passion for truth, his contempt for verbosity, his hatred of sham and his clarity of exposition. If a motto were wanted for this work nothing could be more appropriate than the words we read every week on the cover of *Nature* :

" To the solid ground
Of Nature trusts the mind that builds for aye."

Dines assuredly " built for aye," and this book affords the best evidence of the solidity of the ground on which he built.

Problems in Meteorological Optics

It is well known that the " circumscribed halo " changes in form as the elevation of the sun increases. The metamorphosis is illustrated in the diagram, which was constructed by Prof. W. J. Humphreys. As the circumscribed halo closes in on the halo of 22° the reverse curvature at the points of contact is lost. Mr. S. E. Ashmore, who observed the metamorphosis recently, has asked me to say at what elevations of the sun the curvature at the points in question changes sign.

The theory of the circumscribed halo is well known; it depends upon the assumption that the light is refracted through hexagonal prisms with their axes horizontal, and that the effective rays which determine the position of the halo pass through the prism with minimum deviation. By straightforward, though not very elegant, mathematics I find that the condition that the circumscribed halo may have no curvature at the upper point of contact is:

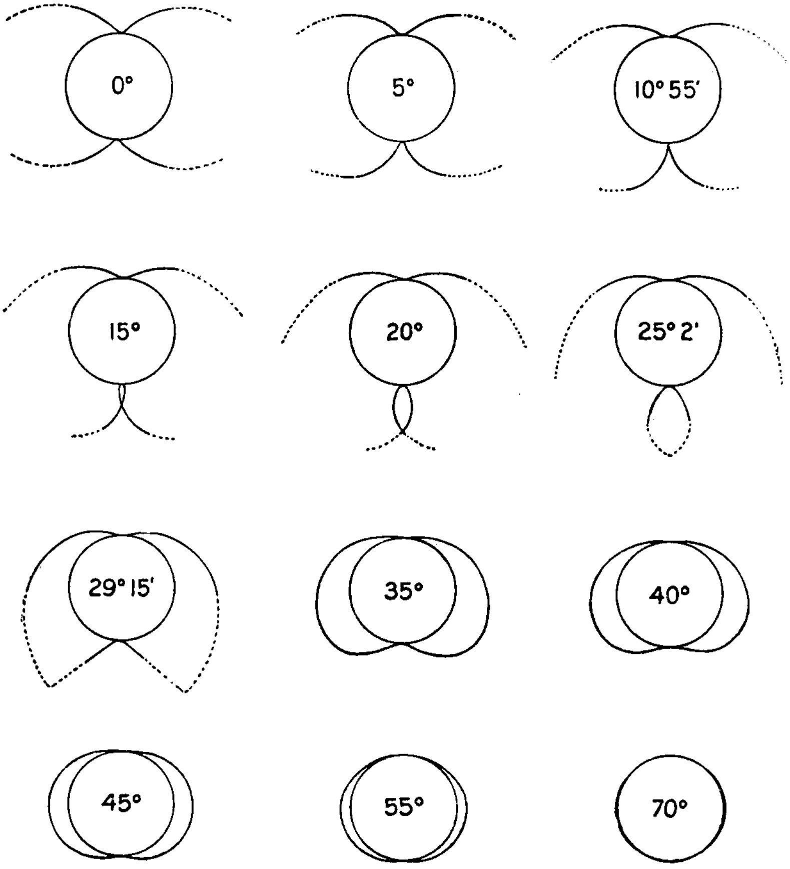
$$(\tan H + \tan \tfrac{1}{2} D)^2 = \frac{4}{\sin 2D}\left[\left(1 - \frac{1}{n^2}\right) \tan \tfrac{1}{2}(D+A) - \tan \tfrac{1}{2} D\right]$$

In this equation D is the minimum deviation of the light, A the refracting angle, n the index of refraction for ice and H the height of the sun. Writing $A = 60°$, $n = 1.31$, $D = 21° \ 50'$, I find that $H = 38\tfrac{1}{2}°$. The condition for no curvature at the lower point of contact is the same as that for the upper point, except that a minus sign is to be substituted for the + in the bracket on the left. With the same assumptions I find that $H = 49\tfrac{3}{4}°$.

It will be seen that these results are consistent with Pernter's diagrams, which were used by Prof. Humphreys to make the composite diagram which we have borrowed.

A second question raised by Mr. Ashmore is at what elevation of the sun can parhelia occur on the circumscribed halo.

Parhelia are produced by the refraction of light by prisms with vertical axes. It is an instructive little experiment to hold up a prism with its axis vertical and notice how such objects as window frames seen through the prism are beautifully curved. If a number of lights were placed one above the other the topmost light as seen through the prism would appear furthest from its actual position. Similarly when the sun is high in the heavens the distance of a parhelion is greater than when the sun is low. We have seen that the circumscribed halo shrinks as the sun's elevation increases; at the same time the distance between sun and parhelia increases, so that the parhelion, as it moves outwards, will for *some* elevation be exactly on the circumscribed halo. We are asked to find that elevation.



The Metamorphosis of arcs touching the 22° halo
Upper and lower tangent arcs at solar elevations indicated
(*Reproduced from Philadelphia, Pa., J. Frank. Inst., Vol.* 188, 1919, p. 630)

To solve Mr. Ashmore's problem we have to find the condition that light coming from the parhelion may have been refracted either by a vertical prism in the ordinary way or by a horizontal prism, both prisms producing the same deviation. In the first place it is to be noticed that the plane containing the rays from the sun and the parhelion must be equally inclined to the vertical and horizontal, *i.e.*, must have an inclination of 45°. It can now be proved that, if the distance in azimuth betwen sun and parhelion is $2B$, whilst the elevation of the sun is H, then :

$$\cos B = \tan H$$

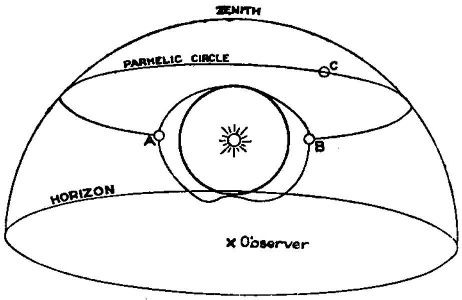
$$\text{and } (3 - n^2) \tan^2 B + 2\sqrt{3} \tan B - (2n^2 - 2) = 0$$

Solving these equations I find that $B = 20° \; 0'$, $H = 43° \; 13'$, and further, that the distance betwen the parhelion and the sun should be 28° 52′. By comparisons of the solutions of the two problems it appears that when the parhelion is on the circumscribed halo that halo is curved downwards at both points of contact.

The other point in which Mr. Ashmore is interested is why the horizontal circle, or mock sun ring, is generally not seen between the parhelia and the sun. This has been discussed before and the answer seems to be that in the neighbourhood of the 22° halo and especially outside the halo there is much light refracted through the prisms, but not with minimum deviation. The parhelic circle would not be perceived against the bright background. Inside the 22° halo, and especially quite close to the sun, the general glare would make the mock sun ring faint by comparison. Moreover, this ring is produced by light reflected by the facets of vertical prisms and near the sun the effective area of the facets is small. Perhaps it is more remarkable that the ring is sometimes described as going right through the sun than that in observations such as Mr. Ashmore's it stops short.

F. J. W. WHIPPLE.

On April 15th last I was at Hamble, near Southampton, and was naturally watchful for the appearance of Bishop's Ring or other coronæ consequent on the recent volcanic eruption. At 14h. 4m. my attention was directed upwards by an aeroplane, and I saw the phenomena indicated in the diagram, all visible simultaneously. The halo of 22° was brilliant and prismatic, likewise the circumscribing ellipse. Both had the red nearest the sun. A and B were bright parhelia, with spectral colours, red on the inside, situated at opposite ends of the maximum diameter of the ellipse. From the parhelia stretched the parhelic circle, right round the sky, but between



The partial ellipse marked "parhelic circle" represents the intersection of a horizontal plane with the vault of the sky at an elevation of 42° (at 14h. 4m.)

A and B it was totally invisible. The parhelic circle is seldom observed between the parhelia of 22° and the sun owing to the brilliance of the latter. However Mr. A. Moon has recorded an observation of it[*] on October 19th, 1930, and another[†] on April 18th, 1931. In my observation the parhelic circle was white; the anthelion was invisible, but a paranthelion C of 120° became faintly visible as a colourless patch of illumination on the east side of north at 14h. 33m. The other paranthelion, if it had existed, would have been hidden by clouds. The halo of 46° was invisible the whole time. The remoteness of the locality from civilisation precluded my obtaining a theodolite, but my estimates were made with care. The semi-major axis of the ellipse was about 5° greater than the radius of the halo, *i.e.*, the major axis of the ellipse was about 54°. Angot[‡] states that the major axis is usually about 64°, and N. H. Smith[§] gives an observational value of 58°. I saw no trace of parhelia on the halo of 22°. It is according to theory, and well illustrated by observation in this case, that the sky is darkest inside the 22° halo, and less dark, but not normal, between the halo and the ellipse. The morning had been stormy, and beneath the structureless uniform sheet of cirrostratus, heavy mammato-cumulus spread over from the north-east. The phenomenon was very faint at 14h. 40m, but at 15h. 5m. I could still distinguish the arcs and parhelia.

There are several points worthy of note in this display. Firstly, the inferior arc of contact to the ellipse was normal, not inverted (a normal arc is convex to the sun) and hence the ellipse bore a curious deformation at the region of the shortest diameter. Secondly, in a brief scrutiny of the available literature, I have been unable to find a reference to parhelia on the circumscribing ellipse. They were not paranthelia, and they cannot be regarded as secondary parhelia of the 22° mock-suns (as Bravais has suggested for those of 46°) since the latter were absent. I have observed parhelia displaced perhaps a degree outside the halo; Angot[‡] says that they go further afield with increase in the sun's altitude, and Dr. Whipple[||] states the same for paraselenæ. But it is difficult to explain away 5° or even more on this theory. And in this case was it merely an accident that the parhelia were on the ellipse?

My last remark is to voice a little uncertainty as to the minimum value of the sun's altitude necessary for the existence of the ellipse. Angot[‡] states that the arc of contact changes its curvature when the sun is 31° up; Whipple quotes it as about

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[*] *London, Meteorological Magazine*, 64, 1931, p. 287.

[‡] Loc. cit., 66. 1931, p. 101.

[‡] Traité Elémentaire de Météorologie, 1907, p. 269.

[§] *London, Meteorological Magazine*, 63, 1928, p. 140.

[||] Loc. cit., 66, 1931, p. 167.

40°. These conditions were satisfied on April 15th. But Angot states that for the ellipse the sun must be 45°, which was not the case in my observation. Finally, can anyone explain why the parhelic circle stopped abruptly at the parhelia?

All my observations were made with the unaided eye.

S. E. ASHMORE.

Windwhistle Cottage, Grayshott, Hindhead, Surrey. *April 22nd,* 1932.

I observed here last Friday, April 15th, a very complete halo-display at about 5 p.m. The sky was covered with a very light cirrus film, and, in addition to the usual 22° ring, which was complete and quite strongly coloured, the north and south mock-suns were distinctly seen, with a portion of the horizontal halo outside each of them. Also there was a clearly defined upper arc of contact, which caused the 22° ring to be very bright at that point. Around the whole was the 45° halo, not bright but quite distinct. This is the first time that I have ever seen this latter ring, although I have looked for it often.

After dark there was a lunar halo of 22°, but not nearly so complex as the afternoon display.

E. W. GOODMAN.

Old Dean Hall, Camberley, Surrey. *April 17th,* 1932.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, May 18th, at 49, Cromwell Road, South Kensington, Prof. S. Chapman, F.R.S., President, in the Chair.

G. Bransby Williams, M.Inst.C.E.—The Rainfall of Assam.

This paper deals with the geographical distribution of the mean annual rainfall of the province of Assam. The subject is of special interest from a meteorological point of view. Assam is the wettest province of the Indian Empire, and contains Cherrapunji (where the mean annual rainfall is 460 inches), reputed to be the wettest place in the world. The period of the south-west monsoon is of greater length in Assam and Burma than in north and central India, and there is a marked difference between the seasonal distribution of the rainfall in these countries. Tables appended to the paper show the variations from the mean of the average rainfall during periods of wet and dry consecutive years. The probability of the year's rain at any station in Assam being less than any given percentage of the mean has been worked out. It is found that the chance is 400 to 1 against the rainfall in any one year being below 50 per cent. of the mean.

J. Wishart, M.A., D.Sc.—On the secular variation of rainfall at Rothamsted (*Memoirs,* Vol. 3, No. 27).

A detailed study of the rainfall at Rothamsted over the 76 harvest years 1854-1929, has revealed the fact that not only have there been sensible changes in the average yearly rainfall of a similar character to those observed at other stations in England and Wales, but the distribution of rainfall throughout the year has changed. The maximum in autumn (and equally the minimum in spring) occurs significantly later to-day than was the case 76 years ago, but there is some sign that this movement is now reversing its direction, as appeared to have happened towards the end of the eighteenth and again in the middle of the nineteenth centuries, as judged from early records at a number of other stations. It would be interesting to have similar detailed analyses of the rainfall data at other places.

C. E. P. Brooks, D.Sc., and Theresa M. Hunt.—The zonal distribution of rainfall over the earth (Memoirs, Vol. 3, No. 28).

The mean annual rainfall in each five-degree zone was calculated separately for the land and sea areas by a planimetric method, using the best available rainfall charts for each country or ocean. The results show maxima over the land in latitude 0-5°S., and 55°-60°S., a minimum about latitude 30°S.; over the sea, maxima about 50°N., 0-10°N., and 40-45°S., minima about 40°-50°N., 20°-30°N., and 20°S. The figures are compared with those obtained by previous investigators. The average zonal rainfalls in each month are then computed from the annual figures by means of the annual variation at a representative series of stations, island stations being employed for the oceans. An appendix gives the average rainfall of a number of separate countries.

OFFICIAL PUBLICATIONS

The following publication has recently been issued:—

Geophysical Memoirs. No. 54. *The Structure of wind over level country.* Report on experiments carried out at the Royal Airship Works, Cardington. By the late M. A. Giblett, M.Sc. (Superintendent of the Airship Division of the Meteorological Office) and other members of the staff of the Office (M.O. 331d).

The wind blowing over the surface of the earth does not flow in a steady stream but is composed of a succession of gusts and lulls; and just as the designer of a pier needs to know in what way his structure will be buffeted by the waves of the sea, the engineer, and even more the designer of aircraft, needs to know how his structures will be buffeted by the gusts of the wind. To gain some knowledge of the details of these buffetings some important investigations have been made by the Meteorological Office at Cardington, Beds., during the last five years.

This publication contains a description of the instruments used and the results obtained. The instruments were anemometers with special clocks by which the time scales were exaggerated in such a way as to show the details of the air flow during the gusts and lulls. A network of such anemometers was formed so that the change of air flow during the gusts could be followed from place to place.

The general results of these investigations was to reveal that the structure of the wind is very different when the air is being heated from below by warmer ground, a condition which is generally associated with the daylight hours, from what it is when the air is being cooled from below by colder ground. A theory of the structure of wind is put forward which enables a mental picture to be formed of how gusts and lulls occur.

The memoir has copious appendices giving the actual values of the measurements made, and it is interesting to learn that on one occasion when the wind was blowing betwen 20 and 30 miles per hour there was a sudden change of 135° in one minute. On another occasion during a thunderstorm there was an increase of wind speed from calm to nearly 50 miles per hour in less than three minutes.

Correspondence

To the Editor, *The Meteorological Magazine.*

Grey Rain

On May 1st a very heavy thunderstorm occurred here between 2.30 and 3.10 p.m. It was accompanied by very heavy rainfall and some hail. The darkness was very pronounced. During the storm 0.65 inches of rain fell, of which some 0.50 fell in about 10 minutes. But what is more worthy of note, the rain water as seen in the measuring glass of the gauge was discoloured a deep grey hue—about the tint of grey flannel—suggesting the presence in the upper atmosphere of volcanic ash caused by the recent Andes eruptions.

The rainfall in a succeeding storm later in the afternoon was quite clear.

John B. Karslake, Lt.-Col.

Silchester, Nr. Reading, Hants. May 14th, 1932.

A Rapidly Dissolving Anvil Cloud

Not having witnessed before such a quick change in the appearance of an anvil cloud, perhaps the occurrence may be considered sufficiently noteworthy to record.

After about four hours' continuous rain during Friday afternoon, April 29th, 1932, a welcome streak of blue sky became visible along the southern horizon. At 17h. 55m. G.M.T. a column of dense white cirrus was seen in the south, rising apparently from behind the cumulus tops low on the horizon and cut off at the top by the receding cloud layer from which rain was still falling. At 18h. 10m. G.M.T. a complete anvil cloud was revealed. The lateral extension was decidedly cirriform and the pointed end (to the right) unusually long. After a few minutes' observation the dense vertical part was found to be rapidly shrinking, more especially at the top and bottom, and by 18h. 22m. G.M.T. it had disappeared. Eight minutes later the lateral extension to the left had dispersed and the pointed end, extending from roughly south-west to west-south-west, was moving from approximately 155° and its wispy margins were dissolving slowly. It was finally lost to view behind high strato-cumulus in the west at 18h. 40m. G.M.T.

J. S. SMITH.

Royal Aircraft Establishment, S. Farnborough, Hants. May 7th, 1932.

Halo Structure at Waringstown

Mr. W. Gibson, of Waringstown, Co. Down, has forwarded a sketch of halo phenomena which he observed from there on April 27th, 1932. He writes: ". . . associated with a falling barometer and a somewhat gusty SSW. wind, the lower part of the southern sky was covered with alto- and cirro-stratus cloud, but higher up and more eastward the sun was shining strongly through a very light, almost insignificant, veil of cirro-nebulæ, whilst ragged billowy clouds of the cirro-cumulus type, apparently propelled by a strong upper current of air passed northwards from the cirri-status cloud bank. At 9.15 a.m. G.M.T. a magnificent halo complex began to form around the sun, and at 9.30, when again observed, the structure was more complete and uniform, besides exhibiting the rainbow spectrum. A thickening of the upper part vertically above the sun suggested the formation of a tangent arc of contact, faintly seen with down-turned ends. At 9.35 a.m. G.M.T. a complete halo of 22° of arc shone strongly, the colours varying from a distinct red inside to a mauve on the outside. East and west of the sun, and one degree outside this halo, and almost on the same plane as the sun, two faint parhelia or mock suns were seen, together with two white parhelic arcs of a mock sun ring, which if complete would have passed over the sun. The parhelic arcs had a characteristic upward curvature. The parhelia and tangent arcs faded about 10 a.m. G.M.T., but the halo, incomplete at times, was seen during the remainder of the day, after which rainy conditions set in."

NOTES AND QUERIES

Comparison of Screen and Hangar Minimum Temperatures

When the responsibility of issuing frost warnings first fell upon the local meteorological officers at R.A.F. aerodromes, it was found that such information as could be given about the anticipated minimum temperature in the free air was not sufficient. A statement such as "air temperature expected to fall to 26°F." conveyed to the R.A.F. personnel concerned inadequate means of foreseeing how such a temperature would affect the water and oil in the engines of their aeroplanes, housed in comparatively warm hangars. It was therefore usual for those receiving the forecast to ask the meteorological officer what the minimum temperature was likely to be in the hangars themselves.

In order that a satisfactory reply to such questions could be given at this station, Leuchars, a minimum thermometer was exposed on one of the central piers of a service brick-built hangar, at a height of 7 feet 9 inches above the ground, which is the mean height of the water-cooled aeroplane engines in use here. Readings were taken throughout three winters at 9h. G.M.T. and compared with the minimum temperatures recorded in the screen during the previous 24 hours. With these readings a dot diagram was constructed to give the difference hangar minimum minus screen minimum with different values of screen minimum.

The observations were made during the months of November, December, January, February and March, since the average minimum during these months at Leuchars is between 34° and 36°F. Table I shows the number of reliable observations available :—

TABLE I.—NUMBER OF OBSERVATIONS AVAILABLE.

Screen Minimum °F.	November	December	January	February	March	Total
20 - 22	—	—	—	3	—	3
22 - 24	2	—	2	4	2	10
24 - 26	4	3	6	2	1	16
26 28	4	—	7	5	5	21
28 - 30	4	3	8	8	7	30
30 - 32	2	7	11	9	10	39
32 34	3	9	8	5	6	31
34 - 36	2	4	10	11	4	31
36 - 38	2	3	2	1	4	12
38 40	2	2	—	—	2	6
40 - 42	—	5	—	1	2	8
42 - 44	1	—	—	—	4	5
44 - 46	—	3	—	—	—	3
TOTAL -	26	39	54	49	47	215

The results given by examination of dot diagrams are set out in Table II.

For the lower values of night minima, the difference between hangar minimum and air minimum is greatest during the month of March, followed in order by November, December, January and February, when the difference is least. For the highest values of night minima the difference tends to become small and more uniform over the different months.

TABLE II.—DERIVATION OF HANGAR MINIMA FROM SCREEN MINAMA.
I.—Difference derived from dot diagrams.
II.—Derived Hangar Minimum.

Screen Minimum °F	November		December		January		February		March		Winter	
	I	II	I	II	I	II	I	II	I	II	I	II
22	7·3	29·3	6·4	28·4	4·9	26·9	4·8	26·8	—	—	5·3	27·3
23	6·9	29·9	5·9	28·9	4·6	27·6	4·3	27·3	—	—	5·0	28·0
24	6·5	30·5	5·6	29·6	4·3	28·3	4·0	28·0	—	—	4·6	28·6
25	6·0	31·0	5·2	30·2	4·0	29·0	3·6	28·6	—	—	4·3	29·3
26	5·5	31·5	4·9	30·9	3·8	29·8	3·3	29·3	7·0	33·0	4·0	30·0
27	**5·0**	**32·0**	4·6	31·6	3·5	30·5	3·1	30·1	6·1	33·1	3·7	30·7
28	4·6	32·6	**4·2**	**32·2**	3·3	31·3	2·8	30·8	5·2	33·2	3·4	31·4
29	4·2	33·2	3·9	32·9	**3·0**	**32·0**	2·5	31·5	4·4	33·4	**3·1**	**32·1**
30	3·8	33·8	3·6	33·6	2·8	32·8	**2·3**	**32·3**	3·9	33·9	2·9	32·9
31	3·4	34·4	3·3	34·3	2·6	33·6	2·1	33·1	3·5	34·5	2·7	33·7
32	3·1	35·1	3·1	35·1	2·3	34·3	1·9	33·9	3·2	35·2	2·5	34·5
33	*2·8*	*35·8*	*2·8*	*35·8*	2·1	35·1	1·6	34·6	*2·9*	*35·9*	*2·3*	*35·3*
34	2·5	36·5	2·4	36·4	*1·8*	*35·8*	*1·4*	*35·4*	2·6	36·6	2·1	36·1
35	2·3	37·3	2·1	37·1	1·5	36·5	1·2	36·2	2·4	37·4	2·0	37·0
36	2·0	38·0	1·8	37·8	1·3	37·3	1·0	37·0	2·2	38·2	1·8	37·8
37	1·8	38·8	1·5	38·5	1·0	38·0	0·8	37·8	2·0	39·0	1·6	38·6
38	1·5	39·5	1·3	39·3	0·8	38·8	0·7	38·7	1·9	39·9	1·4	39·4
39	1·2	40·2	1·1	40·1	0·6	39·6	0·5	39·5	1·8	40·8	1·3	40·3
40	1·0	41·0	0·9	40·9	0·4	40·4	0·4	40·4	1·7	41·7	1·2	41·2

It is agreed among the service personnel here that they would take precautions against frost if a hangar minimum of less than 36°F. were expected. This level is shown in italics in Table II, and is seen to occur with an air minimum of 33° to 34°F. in any winter month. The division at freezing-point is shown in heavy type in Table II, and shows as being most likely in February, and least likely in March.

The critical level of 30·4°F. is likely to be reached in a hangar if the air minimum is expected to be 24°F. in November, 25°F. in December, 27°F. in January, and 28°F. in February. It has not been recorded during March.

In general, for the winter months as a whole, there is danger of freezing point being reached in a hangar if a screen minimum of 27°F. or less is expected; if 28° to 30°F. is anticipated in the air, the risk of freezing is small, while for 30°F. or above it is very slight, except in February. For low temperatures outside, the hangar is much warmer; for temperatures about 40°F. it is almost as warm outside as in.

R. H. MATHEWS.

The mildness of the winter 1931-2 in Scotland in comparison with previous winters.

During the period October to March very mild conditions prevailed generally in Scotland, the mean temperature over the country as a whole being the highest on record, this record extending from 1866 to the present day. Since the winter of 1866-7 the next warmest winter was 1920-1, on which occasion the mean temperature for the country was 0.3°F. lower than in last winter. The winters of 1873-4, 1881-2 and 1924-5 were each 0.5°F. lower. Reliable records prior to 1866 were few and insufficient to give a comparatively accurate average for the country as a whole. Mean temperature values, however, for the Edinburgh district from 1764 are given in Mossman's "Meteorology of Edinburgh." An examination of these records for the winter six months, October to March inclusive, when taken in conjunction with the past winter, indicates that the winter of 1845-6 was for Edinburgh 0.1°F. warmer than that of 1931-2, while the winter of 1857-8 equalled that of last winter. From the above it might be deduced that the winter of 1931-2 (October to March), with the exception of perhaps the winter of 1845-6, was perhaps the mildest winter in Scotland for at least 168 years. There was in this period, October, 1931 to March, 1932, very little snow in Scotland; in April, however, most districts experienced snow, the month of April being cold. May was also cold and, in spite of the open winter, these two months resulted in plant growth being greatly retarded. It was not until the approach of June that the countryside began to exhibit full leaf.

J. Crichton.

The Rainfall of May, 1932.

In spite of the recent wet Mays of 1924, 1925 and 1931, that of 1932 stands out for the frequency of cyclonic rains over England and Wales, some of which were unusually heavy. The month will be remembered for the widespread flooding, including that in the Don Valley at Bentley, of the Trent at Burton and Nottingham, and of the Severn and Avon in Worcestershire. The total rainfall was less than the average over most of the north-west of Ireland and of Scotland, many stations reporting less than 80 per cent. of the average. Over the British Isles as a whole the general rainfall was 174 per cent. and there were four wetter Mays in the series back to 1870, *viz.*, 1925, 1924, 1886 and 1878 with 181, 187, 175 and 176 per cent. respectively.

Over the English Lake District little more than the average was recorded, but over most of England and Wales the total rainfall exceeded twice the average. More than three times the average was recorded over a large area in central England stretching from Huddersfield to Newbury, while over part of Worcestershire there was just over four times the average.

The general rainfall over England and Wales was 221 per cent. of the average, compared with 217 in May, 1924, 206 in May, 1886, and 205 in May, 1878. Values for earlier years back to 1727 have been computed recently. There were six other Mays with more than twice the average. The values for the earliest years are naturally less reliable, but it is reasonable to conclude that May, 1932, ranks as the wettest May during the last 160 years and that there were only two wetter Mays in the whole series.

The prevalence of dull and cool weather is confirmed by the record of evaporation from a free water surface, as measured at Camden Square (London), the total of 1.65 in. being 0.78 in. less than the average and less than that recorded in any May since the record commenced in 1885, with the one exception of that of 1898 with 1.56 in. But for the small evaporation the effects of the flooding might have been appreciably lessened.

At Ombersley (Holt Lock) on the river Severn to the north of Worcester, 8.29 in. or 404 per cent. of the average was recorded, and the total was the largest for any month since the record commenced there in 1879. At Evesham 7.37 in. was recorded, and the month was the wettest there since 1865 with but two exceptions. It was the wettest May on record since before 1855 at Surbiton (Surrey) with 4.51 in.; since before 1874 at Slough (Upton) with 4.47 in.; and since before 1867 at Nottingham with 6.13 in.

The most striking rains occurred on the 1st and 2nd, the 15th, and from the 20th to 23rd. At Ombersley (Holt Lock) the amounts for these days were respectively 1.78 in., 0.56 in., 0.62 in., 1.20 in., 0.82 in., 0.18 in., and 1.26 in., and there were 24 rain days during the month. The rainfall of May 20th and 23rd of 3.46 in. was, however, less than that of May 11th to 13th, 1886, when 3.66 in. was recorded at that station. May, 1886, is remembered for the heavy rains that occurred between the 11th and 13th, and the disastrous floods they produced over the greater part of the west and midland counties of England; at Worcester the flood was higher than any that had occurred there since 1770. The persistent cyclonic rains of these three days gave 7.09 in. at Burwarton, near Brown Clee Hill, in Shropshire, and more than 4 in. was recorded over some 3,500 sq. miles in Shropshire, Hereford, Monmouth, Montgomery, and parts of the adjoining counties.

Over the Thames Valley above Teddington the general rainfall on May 1st, 1932, was 1.02 in., on the 15th 0.41 in., on the 20th to 23rd 1.82 in., and on the 27th to 29th 0.78 in. The general rainfall was 5.32 in. and the month was the wettest May since before 1881, the next wettest May being that of 1924 with 4.76 in. The amounts recorded during the periods June 13th to 15th, 1903, and October 23rd to November 18th, 1894, far exceeded that recently recorded.

Widespread thunderstorm rains occurred over England and Wales on the 1st, 2.15 in. being recorded at Bromyard, which caused flooding in the Frome Valley, and 2.31 in. at Lampeter (Falcondale Gardens) in Cardiganshire. At Upper Heyford, to the north of Oxford, rain commenced at 14h. 40m. on Sunday afternoon, the 1st, and continued but for a break of 2½ hours until 7h. 50m. on the 2nd, as much as 2.04 in. falling within 17hrs. 10min. Many roads in the Chippenham, Swindon and Cricklade area, and in the Ludlow, Kidderminster and Evesham area were rendered impassable. Pershore racecourse, to the south-east of Worcester, was under water to a depth of more than 2 ft. as a result of the flooding of the river Avon.

Heavy falls also occurred on the 15th, 2.79 in. being recorded at Northleach (Sherborne House), in Gloucestershire.

Heavy falls were widespread in the Midlands on the 21st, some of the largest totals being 3.58 in. at Holme-on-Spalding Moor, midway between Hull and York, 3.36 in. at Retford, 3.15 in. at Doncaster (Avenue Road), 3.08 in. at Osgodby to the south of York and at Sleights to the north of Scarborough, 2.87 in. at Pontefract, 2.86 in. at Barnsley (Jordan Hill), 2.85 in. at Wath-upon-Dearne to the west of Doncaster, and 2.65 in. at Thornton Reservoir in Leicestershire. The total rainfall at Wath-upon-Dearne for the 20th to 22nd amounted to 3.75 in. and at Retford to 4.56 in.

J. GLASSPOOLE.

Books Received

The railroads versus the weather, by R. de C. Ward (reprinted from the Proc. Amer. Phil. Soc. lxx, No. 2, 1931).

Deutsches Meteorologisches Jahrbuch, 1930. Freie Hansestadt Bremen. Edited by Dr. A. Mey. Jahrgang 41, Bremen, 1931.

Obituary

We regret to learn of the death of Professor J. W. Gregory, F.R.S., Professor of Geology in the University of Glasgow, at the age of 68. Professor Gregory is famous for his work on the "rift valleys" of eastern Africa, and he is also known to meteorologists for his studies of climatic change, published in the *Geographical Journal* under the title "Is the earth drying up?" and for his theory of the shifting of centres of glaciation. He was an authority on earthquakes, and was drowned in the Urubamba River in northern Peru while leading an expedition to study volcanic movements in that country.

News in Brief

We learn that Mr. C. Stewart has retired from the Directorship of the South African Meteorological Service and has been succeeded by Mr. G. W. Cox as Acting-Director.

It was announced in the list of Birthday Honours that Flying Officer J. B. W. Pugh, Officer Commanding Meteorological Flight, Royal Air Force, Duxford, has been awarded the Air Force Cross.

Corrigendum

MAY, 1932, page 95. The observations given in the note entitled " Maximum day temperatures in early Spring " refer to the meteorological station at South Farnborough, Hants.

The Weather of May, 1932

Pressure was below normal in a belt extending from the Ural Mountains across central Europe and southern Scandinavia to the eastern North Atlantic and from Alaska across British Columbia to the western and south-eastern United States and to north-east Canada, the greatest deficits being 5.2 mb. at Pt. Barrow and 4.9 mb at Kew. Pressure was above normal elsewhere, the greatest excesses being 7.3 mb. at Isafjord and 4.4 mb. at Cagliari (Sardinia). Temperature was above normal over Spitsbergen and most of Scandinavia, but below normal in northern Lapland and central and western Europe. Rainfall was deficient in Spitsbergen, parts of western Sweden and central Europe, and in excess in northern Norway and eastern Sweden being as much as 100 per cent. above normal in eastern Gothaland.

Over the British Isles May, 1932, was remarkable as being the wettest and dullest May on record at many places. Serious flooding occurred towards the end of the month in the Midlands. In the Hebrides, however, the rainfall was below normal, and at Tiree, in the southern Hebrides, sunshine was above normal. The month opened with high pressure over Iceland and low pressure over England and France. Heavy rain fell locally in England, but fair, sunny weather was enjoyed in the north and west. On the 2nd the anticyclone in the north spread southwards, and the fine weather gradually extended over the whole country accompanied by cold northerly winds; 12.8 hrs. bright sunshine were enjoyed at Tiree on the 2nd, 13.4 hrs. at Dundee on the 3rd, and 13.8 hrs. at Valentia on the 6th, but the temperature was low, 44°F. being the maximum at many places in the Midlands and Scotland on the 6th. By this time the depression over Denmark had moved westward and showers followed. Snow showers occurred in eastern Scotland and the Midlands on the 5th, 6th and 7th. The 8th was a sunny day, but a shallow depression off southern Ireland moved eastwards and heavy rain fell in south-east England on the 9th, but over 14 hrs. bright sunshine occurred in parts of Scotland on the 9th, and the 10th was sunny over the whole country. A complete change of weather occurred about the 11th. A deep depression lay over the Atlantic and secondary disturbances moved round it across the British Isles. Temperature rose considerably, and there was heavy local rain, particularly on the 12th and 15th, but many sunny periods. The 14th and 17th were especially sunny, with 13.7 hrs. at Berwick on the 14th and 15.1 hrs. at Tiree on the 17th. Another deep depression approached from the Atlantic on the 18th, and there ensued the warmest spell of the month when 75°F. was recorded at Gorleston, Tottenham and Greenwich on the 20th or 21st. The heaviest rain of the month occurred on the 21st and 22nd and caused severe floods in the Midlands. Subsequently pressure was low to the east and high over the Atlantic giving cool, unsettled weather. Day temperatures fell considerably, at Kew they fell from 74°F. on the 20th to 53°F. on the 25th. Good sunshine records were obtained locally on isolated days, and the 25th was generally sunny. On the 29th another depression approached from the west; temperature rose somewhat, moderate rain occurred in south Ireland on the 30th, but sunshine records were good in Scotland on the 30th and 31st and in east England on the 31st. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	174	—17	Liverpool	121	—78
Aberdeen	135	—52	Ross-on-Wye	104	—99
Dublin	122	—83	Falmouth	172	—59
Birr Castle	133	—49	Gorleston	130	—95
Valentia	171	—32	Kew	114	—87

The special message from Brazil states that the rainfall was scarce in the northern regions with 3.38 in. below normal, irregular in the central regions with .04 in. below normal and plentiful in the south with 1.97 in. above normal. Crops generally in good condition except that excessive rains in the south affected somewhat the wheat and corn crops. Five anticyclones passed across the country. Frosts occurred in the south during the last ten days. At Rio de Janeiro pressure was 0.9 mb. above normal and temperature about 2°F. above normal.

Miscellaneous notes on weather abroad culled from various sources.

A severe storm swept over the Chambéry district on the 9th, and a severe storm also occurred in the Rhineland on the 16th, being especially violent in the village of Güls in the lower valley of the Moselle near Coblenz, where four houses collapsed owing

(*Continued on p.* 128.)

Rainfall: May, 1932: England and Wales.

Co.	STATION	In.	Percent. of Av.	Co.	STATION	In.	Percent. of Av.
Lond .	Camden Square	3·76	213	*Leics* .	Belvoir Castle	5·23	247
Sur .	Reigate, Alvington	4·43	243	*Rut* .	Ridlington	4.31	213
Kent .	Tenterden, Ashenden	2·73	174	*Lincs* .	Boston, Skirbeck	3·56	202
,, .	Folkestone, Boro. San.	2·78	...	,,	Cranwell Aerodrome	4·62	255
,, .	Margate, Cliftonville	2·46	156	,, .	Skegness, Marine Gdns	3·43	202
,, .	Sevenoaks, Speldhurst	3·62	...	,, .	Louth, Westgate	4·01	197
Sus .	Patching Farm	3·62	196	,, .	Brigg, Wrawby St.	4·75	...
,, .	Brighton, Old Steyne	2·70	167	*Notts* .	Worksop, Hodsock	6·54	328
,, .	Heathfield, Barklye	2·66	148	*Derby* .	Derby, L. M. & S. Rly.	6·55	343
Hants .	Ventnor, Roy. Nat. Hos.	4·29	252	,, .	Buxton, Devon Hos.	5·06	163
,, .	Fordingbridge, Oaklnds	4·67	225	*Ches* .	Runcorn, Weston Pt.	4·78	207
,, .	Ovington Rectory	5·28	243	,, .	Nantwich, Dorfold Hall	5·06	...
,, .	Sherborne St. John	4·55	234	*Lancs* .	Manchester, Whit Pk.	4·44	209
Berks .	Wellington College	4·45	239	,, .	Stonyhurst College	5·14	180
,, .	Newbury, Greenham	6·21	331	,, .	Southport, Hesketh Pk	3·60	172
Herts .	Welwyn Garden City	3·71	...	,, .	Lancaster, Strathspey	5·24	...
Bucks .	H. Wycombe, Flackwell	4·63	...	*Yorks* .	Wath-upon-Dearne	6·15	303
Oxf .	Oxford, Mag. College	5·51	308	,, .	Bradford, Lister Pk.	3·94	188
Nor .	Pitsford, Sedgebrook	4·91	257	,, .	Oughtershaw Hall	5·70	...
,, .	Oundle	3·36	...	,, .	Wetherby, Ribston H.	6·03	291
Beds .	Woburn, Crawley Mill	4·92	253	,, .	Hull, Pearson Park	4·51	233
Cam .	Cambridge, Bot. Gdns.	4·05	230	,, .	Holme-on-Spalding	6·78	...
Essex .	Chelmsford, County Lab	3·69	256	,, .	West Witton, Ivy Ho.	3·58	159
,, .	Lexden Hill House	3·06	...	,, .	Felixkirk, Mt. St. John	4·69	249
Suff .	Haughley House	3·08	...	,, .	Pickering, Hungate	4·69	239
,, .	Campsea Ashe	3·44	229	,,	Scarborough	6·58	345
Norf	Norwich, Eaton	...	...	,, .	Middlesbrough	4·46	232
,, .	Wells, Holkham Hall	3·52	219	,, .	Balderdale, Hury Res.	...	...
,, .	Swaffham, The Villa	5·35	294	*Durh* .	Ushaw College	3·99	185
Wilts .	Devizes, Highclere	5·74	317	*Nor* .	Newcastle, Town Moor	3·50	175
,, .	Bishops Cannings	5·33	273	,, .	Bellingham, Highgreen	2·62	113
Dor .	Evershot, Melbury Ho.	5·88	288	,, .	Lilburn Tower Gdns.	2·97	129
,, .	Creech Grange	3·03	149	*Cumb* .	Geltsdale	3·42	...
,, .	Shaftesbury, Abbey Ho.	3·76	178	,, .	Carlisle, Scaleby Hall	3·03	127
Devon .	Plymouth, The Hoe	4·61	223	,, .	Borrowdale, Seathwaite	7·50	109
,, .	Launceston, Werringt'n	4·21	...	,, .	Borrowdale, Moraine	5·24	...
,, .	Holne, Church Pk. Cott.	5·54	175	,,	Keswick, High Hill	3·23	...
,, .	Cullompton	3·73	173	*West* .	Appleby, Castle Bank	3·50	159
,, .	Sidmouth, Sidmount	4·12	210	*Glam* .	Cardiff, Ely P. Stn.	4·34	174
,, .	Filleigh, Castle Hill	3·27	...	,, .	Treherbert, Tynywaun	8·48	...
,,	Barnstaple, N. Dev. Ath	3·12	151	*Carm* .	Carmarthen Friary	4·99	181
,, .	Dartm'r, Cranmere Pool	6·30	...	*Pemb* .	Haverfordwest, School	4·65	186
Corn .	Redruth, Trewirgie	5·03	217	*Card* .	Aberystwyth	4·20	...
,, .	Penzance, Morrab Gdn.	4·87	219	,,	Cardigan, County Sch.	4·43	...
,, .	St. Austell, Trevarna	5·41	223	*Brec* .	Crickhowell, Talymaes	5·30	...
Soms .	Chewton Mendip	6·54	237	*Rad* .	Birm W.W. Tyrmynydd	5·24	153
,, .	Long Ashton	5·93	281	*Mont* .	Lake Vyrnwy	4·43	141
,, .	Street, Millfield	4·73	247	*Denb* .	Llangynhafal	3·27	148
Glos .	Blockley	6·85	...	*Mer* .	Dolgelly, Bryntirion	6·33	191
,, .	Cirencester, Gwynfa	6·18	300	*Carn* .	Llandudno	2·72	143
Here .	Ross, Birchlea	5·64	265	,, .	Snowdon, L. Llydaw 9	11·55	...
,, .	Ledbury, Underdown	6·04	296	*Ang* .	Holyhead, Salt Island	2·53	129
Salop .	Church Stretton	5·03	195	,, .	Lligwy	3·82	...
,, .	Shifnal, Hatton Grange	4·83	235	*Isle of Man*			
Worc .	Ombersley, Holt Lock	8·29	404		Douglas, Boro' Cem.	4·20	166
War .	Birminghm, Edgbaston	6·81	318	*Guernsey*			
Leics .	Thornton Reservoir	6·30	313		St. Peter P't. Grange Rd.	2·63	155

Rainfall: May, 1932: Scotland and Ireland.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt	Pt. William, Monreith	3·30	140	*Suth*	Melvich	3·43	...
,,	New Luce School	3·04	107	,,	Loch More, Achfary	3·51	80
Kirk	Carsphairn, Shiel	3·55	84	*Caith*	Wick	1·40	68
Dumf	Dumfries, Crichton, R.I	2·59	...	*Ork*	Pomona, Deerness	1·14	57
,,	Eskdalemuir Obs.	3.39	103	*Shet*	Lerwick	1·48	71
Roxb	Branxholm	2·45	109	*Cork*	Caheragh Rectory	7·12	...
Selk	Ettrick Manse	2·97	81	,,	Dunmanway Rectory	8·07	237
Peeb	West Linton	3·61	...	,,	Ballinacurra	3·79	160
Berw	Marchmont House	2·32	94	,,	Glanmire, Lota Lo.	4·41	180
E.Lot	North Berwick Res.	2·41	121	***Kerry***	Valentia Obsy	4·94	156
Midl	Edinburgh, Roy. Obs.	2·83	138	,,	Gearahameen	7·40	...
Lan	Auchtyfardle	2·41	...	,,	Killarney Asylum	...	...
Ayr	Kilmarnock, Kay Pk.	2·84	...	,,	Darrynane Abbey	4·63	155
,,	Girvan, Pinmore	3·30	111	*Wat*	Waterford, Gortmore	4·04	176
Renf	Glasgow, Queen's Pk.	2·98	122	*Tip*	Nenagh, Cas. Lough	2·70	109
,,	Greenock, Prospect H.	2·76	80	,,	Roscrea, Timoney Park	2·74	...
Bute	Rothesay, Ardencraig.	2·97	98	,,	Cashel, Ballinamona	3·54	147
,,	Dougarie Lodge	2·61	...	*Lim*	Foynes, Coolnanes	1·61	69
Arg	Ardgour House	3·93	...	,,	Castleconnel Rec.	2·75	...
,,	Glen Etive	3.98	80	*Clare*	Inagh, Mount Callan	2·98	...
,,	Oban	2·67	88	,,	Broadford, Hurdlest'n.	3·78	...
,,	Poltalloch	3·43	119	*Wexf*	Gorey, Courtown Ho.	5·52	248
,,	Inveraray Castle	3·52	89	*Kilk*	Kilkenny Castle	2·97	134
,,	Islay, Eallabus	2·32	87	*Wick*	Rathnew, Clonmannon	4·74	...
,,	Mull, Benmore	4·20	...	*Carl*	Hacketstown Rectory	5·09	196
,,	Tiree	1·20	...	*Leix*	Blandsfort House	3·07	126
Kinr	Loch Leven Sluice	3·81	156	,,	Mountmellick	2·60	...
Perth	Loch Dhu	4·80	107	*Offaly*	Birr Castle	2·75	123
,,	Balquhidder, Stronvar	2·58	...	***Kild'r***	Monasterevin	2·83	...
,,	Crieff, Strathearn Hyd.	3·16	127	*Dublin*	Dublin, FitzWm. Sq.	3·30	161
,,	Blair Castle Gardens	2·80	138	,,	Balbriggan, Ardgillan.	3·77	181
Angus	Kettins School	2·45	101	***Meath***	Beauparc, St. Cloud	3·63	...
,,	Dundee, E. Necropolis	2·91	139	,,	Kells, Headfort	3·50	130
,,	Pearsie House	3·73	...	*W.M*	Moate, Coolatore	1·97	...
,,	Montrose, Sunnyside	...	...	,,	Mullingar, Belvedere	3·33	136
Aber	Braemar, Bank	3·76	158	*Long*	Castle Forbes Gdns.	3·15	124
,,	Logie Coldstone Sch.	3·81	153	*Gal*	Ballynahinch Castle	2·58	72
,,	Aberdeen, King's Coll.	2·82	121	,,	Galway, Grammar Sch.	2·61	...
,,	Fyvie Castle	2·46	95	*Mayo*	Mallaranny	2·63	...
Moray	Gordon Castle	2·07	98	,,	Westport House	2·64	93
,,	Grantown-on-Spey	3·82	164	,,	Delphi Lodge	6·51	108
Nairn	Nairn, Delnies	2·62	146	*Sligo*	Markree Obsy	2·77	101
Inv's	Ben Alder Lodge	3·68	...	*Cavan*	Belturbet, Cloverhill	2·37	95
,,	Kingussie, The Birches	3·17	...	*Ferm*	Enniskillen, Portora	2·71	...
,,	Loch Quoich, Loan	3·24	...	*Arm*	Armagh Obsy	2·68	113
,,	Glenquoich	3·93	72	*Down*	Fofanny Reservoir	6·67	...
,,	Inverness, Culduthel R.	3·09	...	,,	Seaforde	3·83	146
,,	Arisaig, Faire-na-Squir	...	...	,,	Donaghadee, C. Stn.	2·24	99
,,	Fort William, Glasdrum	3·28	...	,,	Banbridge, Milltown	2·43	...
,,	Skye, Dunvegan	2·49	...	*Antr*	Belfast, Cavehill Rd.	3·20	...
,,	Barra, Skallary	1·13	...	,,	Glenarm Castle	2·76	...
R & C	Alness, Ardross Castle	3·38	130	,,	Ballymena, Harryville	2·18	76
,,	Ullapool	1·57	61	*Lon*	Londonderry, Creggan	2·17	83
,,	Achnashellach	2·57	...	*Tyr*	Omagh, Edenfel	2·96	114
,,	Stornoway	1·50	...	*Don*	Malin Head	1·66	...
Suth	Lairg	2·93	115	,,	Dunfanaghy	2·30	...
,,	Tongue	2·34	98	,,	Killybegs, Rockmount.	1·82	51

Climatological Table for the British Empire, December, 1931

STATIONS	PRESSURE		TEMPERATURE										PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean	Relative Humidity	Mean Cloud Am'nt					
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Per-centage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1026·2	+12·5	59	24	46·2	38·3	42·3	+ 2·0	39·3	87	7·7	0·54	— 1·75	8	0·9	12
Gibraltar	1022·1	+ 2·0	70	40	62·9	47·5	55·2	— 0·8	47·2	79	4·1	4·51	— 1·10	8	..	..
Malta	1017·5	+ 1·3	68	44	59·9	52·4	56·1	— 1·8	52·2	78	7·4	3·60	— 0·11	22	3·4	35
St. Helena	1014·6	+ 0·7	69	56	64·9	57·4	61·1	— 0·6	58·0	94	9·9	0·58	..	10	..	..
Sierra Leone	1012·5	+ 1·6	88	69	86·3	74·6	80·5	— 0·9	76·1	79	5·1	1·56	+ 0·14	5	..	..
Lagos, Nigeria	1010·8	+ 0·3	91	75	87·9	76·2	82·1	+ 0·6	77·3	86	7·6	0·93	+ 0·13	2	..	..
Kaduna, Nigeria	1013·1	— 1·2	96	53	92·8	57·0	74·9	+ 1·6	59·8	36	1·5	0·00	0·00	0	..	..
Zomba, Nyasaland	1008·5	+ 0·2	88	60	79·3	64·5	71·9	— 1·2	..	79	8·0	15·27	+ 4·40	27	..	..
Salisbury, Rhodesia	1008·4	— 0·4	84	53	78·5	59·8	69·1	— 0·5	62·2	67	6·7	4·18	— 1·91	12	5·6	42
Cape Town	1015·9	+ 1·6	93	47	78·3	58·3	68·3	+ 0·4	61·1	68	4·6	0·72	— 0·09	9	..	..
Johannesburg	1009·8	+ 0·2	86	48	78·8	55·3	67·1	+ 1·6	57·1	58	3·6	4·37	— 1·06	15	9·5	69
Mauritius	1014·0	0·0	89	67	84·9	70·7	77·8	— 0·5	72·5	63	5·7	1·46	— 3·27	14	9·3	70
Calcutta, Alipore Obsy.	1014·8	— 0·9	81	51	78·3	59·4	68·9	+ 2·4	59·6	85	2·1	0·01	— 0·23	0*	..	..
Bombay	1012·3	— 1·2	93	65	87·7	69·8	78·7	+ 1·3	67·5	72	2·9	0·69	+ 0·64	2*	..	..
Madras	1012·0	— 1·5	85	63	82·0	72·2	77·1	+ 0·4	73·0	85	7·8	10·35	+ 5·00	12*	..	..
Colombo, Ceylon	1009·9	— 0·4	88	69	85·0	73·1	79·1	— 0·4	75·3	81	7·3	15·44	+ 10·32	22	5·6	48
Singapore	..	..	89	72	84·2	73·3	78·7	— 1·2	75·7	85	8·2	11·93	+ 1·37	23	3·3	27
Hongkong	1019·7	0·0	75	42	67·7	59·5	63·6	+ 0·6	58·5	71	6·8	4·55	+ 3·48	7	4·7	43
Sandakan	..	..	91	74	86·9	75·1	81·0	+ 0·8	77·1	87	..	15·01	— 3·63	18	..	..
Sydney, N.S.W.	1013·3	+ 1·4	90	53	73·1	61·9	67·5	— 2·6	63·9	72	6·1	3·35	+ 0·49	11	7·7	53
Melbourne	1014·9	+ 2·2	104	49	74·0	54·9	64·5	— 0·3	57·4	63	4·1	0·60	— 1·67	8	8·1	55
Adelaide	1014·5	+ 1·3	115	51	88·0	60·1	74·1	+ 3·0	60·1	33	3·8	0·22	— 0·78	1	11·6	81
Perth, W. Australia	1012·8	— 0·4	101	55	89·1	66·6	77·9	+ 7·1	63·9	38	3·7	0·37	— 0·19	4	10.8	76
Coolgardie	1012·1	+ 0·9	105	52	92·8	61·9	77·3	+ 1·6	60·9	31	2·1	0·00	— 0·69	0	..	..
Brisbane	1012·5	+ 0·5	98	62	83·3	67·0	75·1	— 1·3	68·4	65	6·3	9·11	+ 4·14	14	8·5	62
Hobart, Tasmania	1013·6	+ 3·9	81	39	66·8	49·5	58·1	— 2·1	52·0	56	5·4	0·17	— 1·82	6	8·5	56
Wellington, N.Z.	1013·5	+ 1·3	74	42	59·1	52·5	55·8	— 4·4	55·4	72	7·0	2·70	— 0·52	10	8·2	54
Suva, Fiji	1010·5	+ 1·9	91	69	84·5	73·3	78·9	— 0·1	74·3	77	6·8	9·50	— 3·02	23	7·1	54
Apia, Samoa	1008·9	+ 0·6	89	71	85·7	72·9	79·3	0·0	75·8	76	5·8	8·98	— 4·91	18	5·7	44
Kingston, Jamaica	1013·9	— 0·1	91	66	86·4	68·9	77·7	0·0	67·4	85	3·4	0·92	— 0·67	3	8·0	72
Grenada, W.I.	1013·5	+ 1·7	90	72	88·3	73·6	80·9	+ 2·7	74·1	75	3·3	6·57	— 0·63	22	..	..
Toronto	1018·9	+ 1·3	51	11	38·8	27·8	33·3	+ 6·2	29·1	79	7·4	2·37	— 0·10	9	2·5	28
Winnipeg	1017·5	— 1·2	37	—12	25·2	13·4	19·3	+13·5	..	..	4·5	0·04	— 0·90	3	..	..
St. John, N.B.	1013·7	— 0·3	50	2	33·4	19·3	26·3	+ 1·9	22·1	74	6·6	3·03	— 1·14	11	3·3	37
Victoria, B.C.	1010·0	— 6.7	53	32	44·9	38·7	41·8	+ 0·7	39·4	88	8·0	2·56	— 3·18	18	1·9	23

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

Climatological Table for the British Empire, Year 1931.

STATIONS	PRESSURE		TEMPERATURE									PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values.				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb	Relative Humidity.	Mean Cloud Am'nt	Am'nt	Diff. from Normal	Days	Hours per day	Per-centage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy. ..	1015·2	− 0·2	77	18	55·8	43·5	49·6	− 0·1	44·9	86	7·8	23·83	+ 0·03	150	3.5	27
Gibraltar..........	1017·2	− 0·7	95	38	72·5	57·0	64·8	+ 0·5	56·4	82	4·4	31·37	− 4·45	81	..	..
Malta	1015·0	− 0·4	104	42	71·5	61·0	66·2	+ 0·1	60·5	74	4·9	26·27	+ 6·41	100	8·1	64
St. Helena	1015·3	+ 0·8	73	51	64·1	57·3	60·7	− 0·8	58·2	94	9·2	29·99	..	205	..	..
Sierra Leone	1012·4	+ 1·0	94	64	86·1	71·6	78·9	− 1·9	76·3	82	5·7	147·30	− 9·93	184	..	..
Lagos, Nigeria	..	..	96	70	86·6	76·2	81·4	+ 0·9	77·1	83	8·6	83·55	+ 11·92	155	..	..
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland ..	1012·1	− 0·2	94	47	78·7	61·4	70·0	+ 0·6	..	70	5·5	56·93	+ 2·39	112	..	..
Salisbury, Rhodesia ..	1012·4	+ 0·2	92	37	77·8	55·0	66·4	+ 1·1	57·0	57	3·7	28·20	− 3·35	81	8·1	67
Cape Town	1018·0	+ 1·0	102	33	72·1	54·9	63·5	+ 1·2	56·2	78	4·6	19·08	− 5·96	110	..	..
Johannesburg........	1015·7	+ 0·5	88	25	71·0	50·3	60·7	+ 1·0	50·4	55	3·3	29·37	− 3·85	108	8·7	73
Mauritius	1016·1	0·0	89	55	80·8	68·3	74·6	+ 0·6	70·5	71	5·8	83·79	+ 34.13	208	7·9	66
Calcutta, Alipore Obsy.	1007·6	0·0	103	51	88·3	72·7	80·5	+ 1·7	73·2	86	4·9	65·38	+ 1·06	90	..	..
Bombay	1008·5	− 0·7	95	63	87·8	74·8	81·3	+ 0·7	73·6	78	4·3	97·94	+ 25·75	91	..	..
Madras	1008·4	− 0·4	108	63	90·8	75·7	83·3	+ 0·2	75·4	76	5·6	58·53	+ 8·97	65	..	..
Colombo, Ceylon	1010·3	+ 0·6	92	68	86·3	75·4	80·9	− 0·1	77·0	79	6·8	106·38	+ 26·25	231	6·9	57
Singapore	..	..	94	70	88·0	75·1	81·6	+ 0·7	..	..	..	100·67	+ 5·55	201	5·8	47
Hongkong	1012·1	− 0·5	94	40	76·9	69·0	73·0	+ 0·7	68·2	77	7·3	80·39	− 4·74	162	5·0	42
Sandakan	..	..	93	72	88·1	75·2	81·7	+ 0·4	77·5	82	..	92·05	− 32·74	132	..	..
Sydney, N.S.W......	1016·1	+ 0·2	104	38	70·8	56·2	63·5	+ 0·4	58·3	71	5·4	49·22	+ 1·74	153	6·9	57
Melbourne	1016·5	+ 0·2	104	33	66·4	49·0	57·7	− 0·7	52·6	70	6·7	28·63	+ 3·16	164	5·4	43
Adelaide............	1017·7	+ 0·7	115	38	71·9	52·6	62·3	− 0·7	53·7	55	6·3	22·26	+ 1·08	145	7·0	56
Perth, W. Australia ..	1017·1	+ 0·7	104	37	73·6	55·3	64·4	+ 0·2	56·6	60	4·6	39·18	+ 4·81	118	8·0	65
Coolgardie	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Brisbane............	1016·7	+ 0·8	100	42	77·9	60·5	69·2	+ 0·3	62·8	67	5·3	66·71	+ 21·42	132	7·7	64
Hobart, Tasmania	1012·0	− 0·5	86	30	61·0	46·4	53·7	− 0·7	48·1	65	6·4	27·17	+ 3·38	179	5·8	47
Wellington, N.Z.	1015·0	+ 0·3	74	32	57·7	47·5	52·6	− 2·8	50·1	76	6·8	39·49	− 8·55	163	6·0	49
Suva, Fiji	1012·0	+ 0·7	91	62	82·3	72·3	77·3	+ 0·3	73·1	79	6·9	122·60	+ 5·46	250	5·3	43
Apia, Samoa	1009·9	− 0·4	89	66	85·2	74·0	79·6	+ 1·1	76·5	78	6·1	122·16	+ 12·45	182	6·4	53
Kingston, Jamaica....	1012·6	− 1·1	94	62	87·5	72·3	79·9	+ 0·6	71·1	83	4·7	33·22	− 0·37	89	6·8	56
Grenada, W.I.	1013·4	+ 1·0	92	70	87·3	73·9	80·6	+ 1·7	74·0	76	5·1	102·71	+ 28·12	264	..	..
Toronto	1016·0	− 0·6	98	0	57·2	41·5	49·4	+ 4·2	43·7	75	5·9	26·63	− 4·65	124	5·7	45
Winnipeg	10 5·2	− 1·0	100	−21	50·6	32·1	41·4	+ 6·8	..	..	4·8	17·44	− 2·75	91	..	..
St. John, N.B.	1014·2	− 0·4	87	− 6	51·0	36·9	43·9	+ 2·7	39·5	78	6·5	45·52	− 2·56	163	4·8	39
Victoria, B.C.	1016·5	− 0·2	86	31	56·4	44·7	50·5	+ 1·1	47·5	82	5·9	25·95	− 4·36	145	6·3	48

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

(*Continued from p.* 123.)

to the floods and five people were drowned. Much damage was also done to the harvest and communications in the neighbouring districts. The opening to vehicular traffic of the road ~~over~~ the Simplon Pass, which was delayed owing to the heavy snow in April, occurred about the 26th. The ice was breaking up in most harbours of Sweden and Finland, but navigation was still somewhat impeded by ice even on the 25th. (*The Times*, May 10th-27th.)

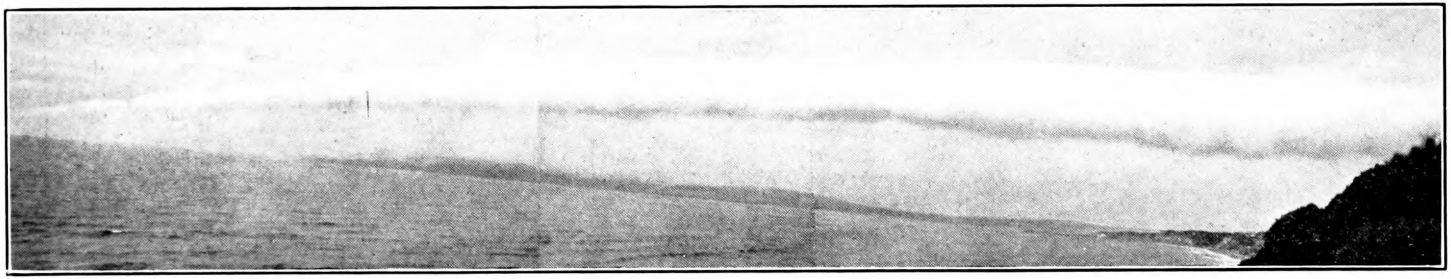
At the beginning of the month 20 people were killed and over 100 injured by a tornado which swept across east Bengal, and as many as 500 people are believed to have been killed by a typhoon over southern Annam. A violent thunderstorm accompanied by hail occurred over several hundred square miles in the United Provinces on the 5th; about 13 people were killed and more than 100 injured. Some of the hailstones were reported to be larger than cricket balls. The storm destroyed the mango crop but helped end the rat pestilence. On the 9th a tornado struck the Mymensingh gaol, Bengal, killing 22 people and injuring about 100 others. The monsoon rains started in Rangoon on the 20th, which is later than usual. Torrential rain is reported to have destroyed the spring crop in 800 villages in north Honan. Eleven people were killed and much damage done by a cyclone over Madras about the 27th. (*The Times*, May 6th-28th.)

Beneficial rains fell for four days over a large area of Queensland, north-west New South Wales, and the north of South Australia, so that the agricultural and pastoral outlooks are much improved. (*The Times*, May 21st-23rd.)

Cool, cloudy weather after heavy rains delayed seeding in western Canada. During the early part of the month the central provinces suffered from severe drought, but later conditions in the western provinces were very good. In the United States temperature was above normal early in the month, but later cold weather spread gradually across from the east to the west. Rainfall was mainly below normal except in part of the Gulf States during the week ending the 24th, when it was much above normal. Heavy rain necessitated some replanting in the American cotton areas, but otherwise the conditions were good. A hurricane off the Bahamas was moving towards Bermuda on the 8th. (*The Times*, May 7th-June 2nd, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin*.)

Rainfall, May, 1932—General Distribution

England and Wales	221	per cent of the average 1881-1915.
Scotland	108	
Ireland	134	
British Isles	174	



ROLL CLOUD SEEN FROM BOURNEMOUTH, 5 P.M., APRIL 30TH, 1932 (*see p.* 132).

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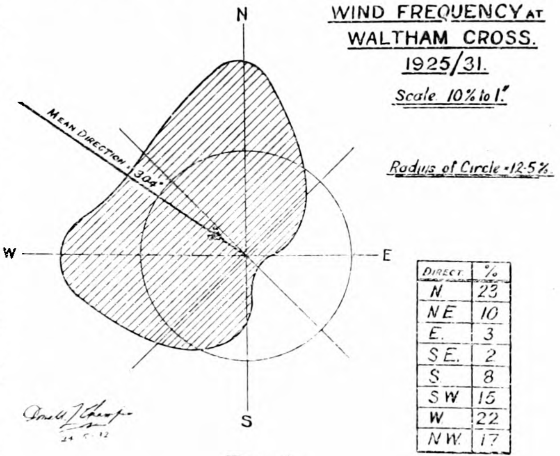
Note on the Sheltering Effect of Hills on Winds of Low Velocity at Waltham Cross

During the past seven years observations of wind direction have been made, twice a day, at fixed hours at Waltham Cross, in the Lea Valley, 12 miles north of London. The annual summaries of frequency, with the exception of 1928, all show a slightly lower frequency of NW. winds than is consistent with a smooth curve of frequencies. The Percentage Frequency Diagram (fig. 1), based on the seven years 1925-31, shows a slight but distinct minimum frequency of NW. winds. The vane used has an excellent exposure, and the minimum at NW. seems too slight to be due to any bias in the instrument. Accordingly I have made the following attempt at a satisfactory explanation of the apparent deficiency of NW. winds.

The map (fig. 2, slightly more than 2 miles to the inch) shows the contour of the country to the west of the station, and it appears that there are four channels, down which light winds might be deflected towards the point of observation.

A light wind approaching the station from the north-west becomes deflected and passes the station as a NNW. wind at 332°. A WNW. wind has two channels, WNW (1) following the same channel as NW. and passing the station as a NNW. wind at 332°; WNW. (2) follows a channel further south, passing on the southern side of the low ridge (A), and passing the stations as a W wind at about 280°. A W. wind has also two channels, W. (1) entering the same channel as WNW. (2), but passing to the north of ridge (A), crosses the station at 294° as a WNW. wind; W. (2) passes further south and crosses the station as a WSW. wind at 256°. WSW. winds are unobstructed, while very slight SW. winds may be deflected into the west-south-west channel by the low peak (B).



DIRECT.	%
N.	23
NE	10
E.	3
SE.	2
S.	8
SW	15
W.	22
NW.	17

Fig. 1.

All winds from N N W., W N W., WSW., etc., are in monthly and annual summaries, equally divided between the adjacent points on either side. Allowing two points for each observation of direction, NNE. becomes N.1, NE.1; N. becomes N.2; NNW. becomes N.1, NW.1; NW. deflected becomes N.1, NW.1; WNW. has two channels and WNW. (1) becomes N.0·5, NW.0·5; WNW. (2) becomes W.1; W also has two channels and W. (1) becomes NW.0·5, W.0·5 W. (2) becomes W.0·5, SW.0·5; WSW. unobstructed becomes W.1, SW1; SW. perhaps slightly deflected becomes, say, W.0·5, SW.1·5; SSW. becomes SW.1, S.1.

Tabulating the results we have:—

Obs. from.	N.	NW.	W.	SW.
NNE.	1·0	—	—	—
N.	2·0	—	—	—
NNW.	1·0	1·0	—	—
NW.	1·0	1·0	—	—
WNW. (1)	0·5	0·5	—	—
WNW. (2)	—	—	1.0	—
W. (1)	—	0·5	0·5	—
W. (2)	—	—	0·5	0·5
WSW.	—	—	1·0	1·0
SW.	—	—	0·5	1·5
SSW.	—	—	—	1·0
Total ...	5·5	3·0	3·5	4·0
Apparent Error	+ 1·5	– 1·0	– 0·5	0

From this table we may assume, that with light winds N. gains 1·5 points at the expense of NW. and W., which lose 1·0 and 0·5 points respectively.

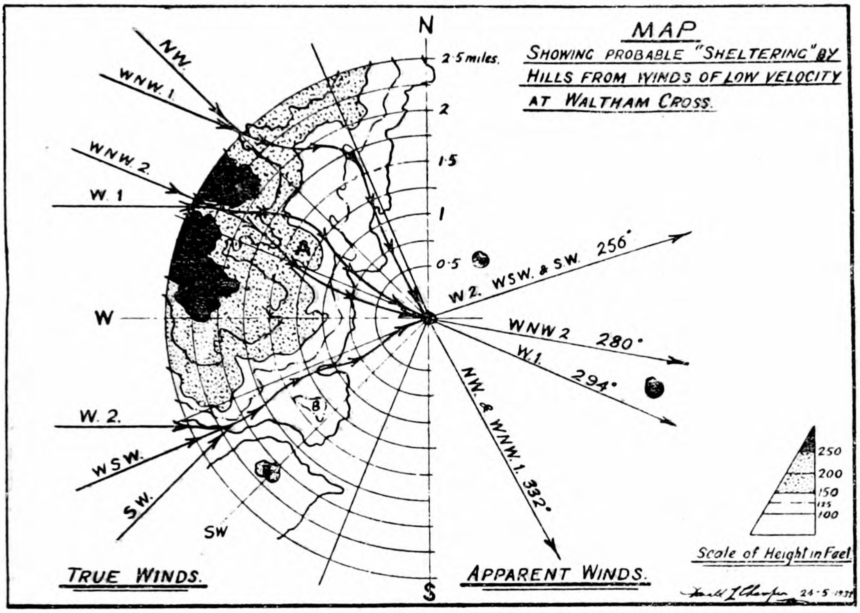

MAP
SHOWING PROBABLE "SHELTERING" BY HILLS FROM WINDS OF LOW VELOCITY AT WALTHAM CROSS.
N
S
W
2·5 miles.
2
1·5
1
0·5
NW.
WNW. 1
WNW. 2
W. 1
W. 2.
WSW.
SW.
SW
A
B
W 2. WSW. & SW. 256°
WNW 2 280°
W.1. 294°
NW. & WNW. 1. 332°
TRUE WINDS.
APPARENT WINDS.
250
200
150
125
100
Scale of Height in Feet.
24-5-193

FIG. 2.

Upon considering these results, one is inclined to wonder why the hills to the east and north do not have similar effects in producing irregularities in the distribution of winds from these quarters. Accordingly I set out to find some explanation of the observed facts, and calculated values of " Sheltering Factors " for each direction of azimuth.

Let S = the factor, then $S = \frac{(H - h)}{D}$ where H = height of obstruction above M.S.L. and h = height of station above M.S.L., both values in hundreds of feet, and D = distance of obstruction from the point of observation in miles and tenths. The highest value of S. in each direction is taken as the " Sheltering Factor."

Direction.	*Factor.*	*Direction.*	*Factor.*
N.	0·12	S.	0·00
NNE.	0·04	SSW.	0·00
NE.	0·14	SW.	0·25
ENE.	0·47	WSW.	0·39
E.	0·13	W.	0·91
ESE.	0·29	WNW.	0·57
SE.	0·12	NW.	1·00
SSE.	0·24	NNW.	0·50

The results tabulated above, indicate that values above 0·5 appear to have effect in the obstruction and deflection of light winds. Only winds between W. and NW. have a higher factor than 0·5, which makes clear the reason why winds from other directions are unaffected.

Unfortunately I have no data giving the force of the wind, only the direction being observed. This makes it difficult to estimate the minimum velocity at which winds are deflected; however, the figures obtained seem to give a reasonable explanation of the apparent deficiency of NW. winds, which is the more accentuated by the corresponding excess of N. winds.

DONALD L. CHAMPION.

Roll Cloud seen at Bournemouth

The photograph of a fine specimen of a roll cloud, which is reproduced as the frontispiece of this number of the magazine, was taken by Mr. G. C. Nickels, of Enfield, at Bournemouth at about 5 p.m. on April 30th, 1932. Mr. Nickels remarks: "The photo does not do full justice to the spectacle, as the cloud was a brilliant white and, as can be judged from the few bits of land visible, must have extended for many miles. I watched the phenomenon for about 10 to 15 minutes, when it gradually broke up, as near as I can explain, into cirro-stratus. I cannot say how long it had formed previously. The headland in the dim distance on the left is The Foreland, and on the right Canford Cliffs." Mr. Nickels is to be congratulated on securing a photograph of so good an example of roll cloud.

An examination of the charts for April 30th, 1932, shows that a stationary depression was situated off the south-west coasts of the British Isles and that a stream of returning maritime polar air was flowing from the south over France and England. The 18h. G.M.T. chart for this date shows a line of rain stretching from Worthy Down (Winchester) in a south-easterly direction to France. This rain was associated with a minor front which had developed in the current of returning maritime polar air, forming probably the boundary between air coming from the south of France and air which had come on a shorter track round the depression.

There is little doubt that the roll cloud photographed at Bournemouth was the frontal cloud of this front. It was seen to the west of Bournemouth at about 5 p.m. (16h. G.M.T.). An examination has been made of the autographic records from Meteorological Office stations in the neighbourhood. The records from Calshot show that a well-defined front passed that station at about 17h. 5m. G.M.T. The passage of the front was accompanied by a sharp fall in temperature, a rapid veer of the wind from east to south-south-east with gusts up to 39 m.p.h., and rain which lasted about an hour. At Boscombe Down the front passed at about 17h. 40m. G.M.T. Here there was a fall of temperature of 8°F. and rain lasting about an hour. No wind records are available from this station. The front reached Worthy Down at 17h. 55m. G.M.T. Here, too, there was about an hour's rain behind the front. At the passage of the front, temperature fell rapidly some 8° or 9°F., and the wind veered suddenly from ESE. to S. with gusts up to 38 m.p.h. The front reached South Farnborough at 19h. 15m. G.M.T., and by this time was becoming diffuse. Temperature fell less and more slowly although there was a quite sharp fall of 4°F. The wind was practically calm and there was no gust, while no rain occurred until an hour after the passage of the front.

From the time at which the roll cloud was seen at Bournemouth and the times of passage of the front at Calshot, Boscombe Down, Worthy Down and South Farnborough, it is clear that the front ran in a north-west—south-east direction and moved in a north-easterly direction.

W. C. Kaye.

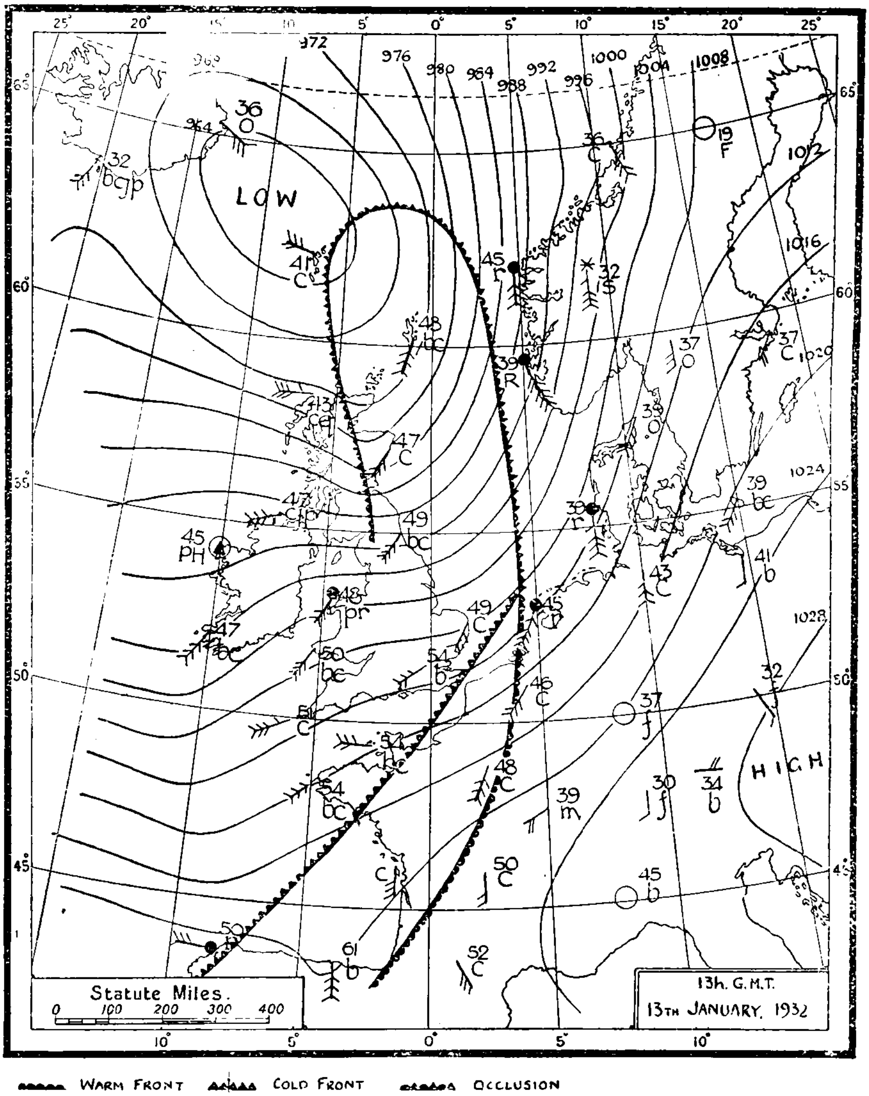
A High Wind at Bell Rock

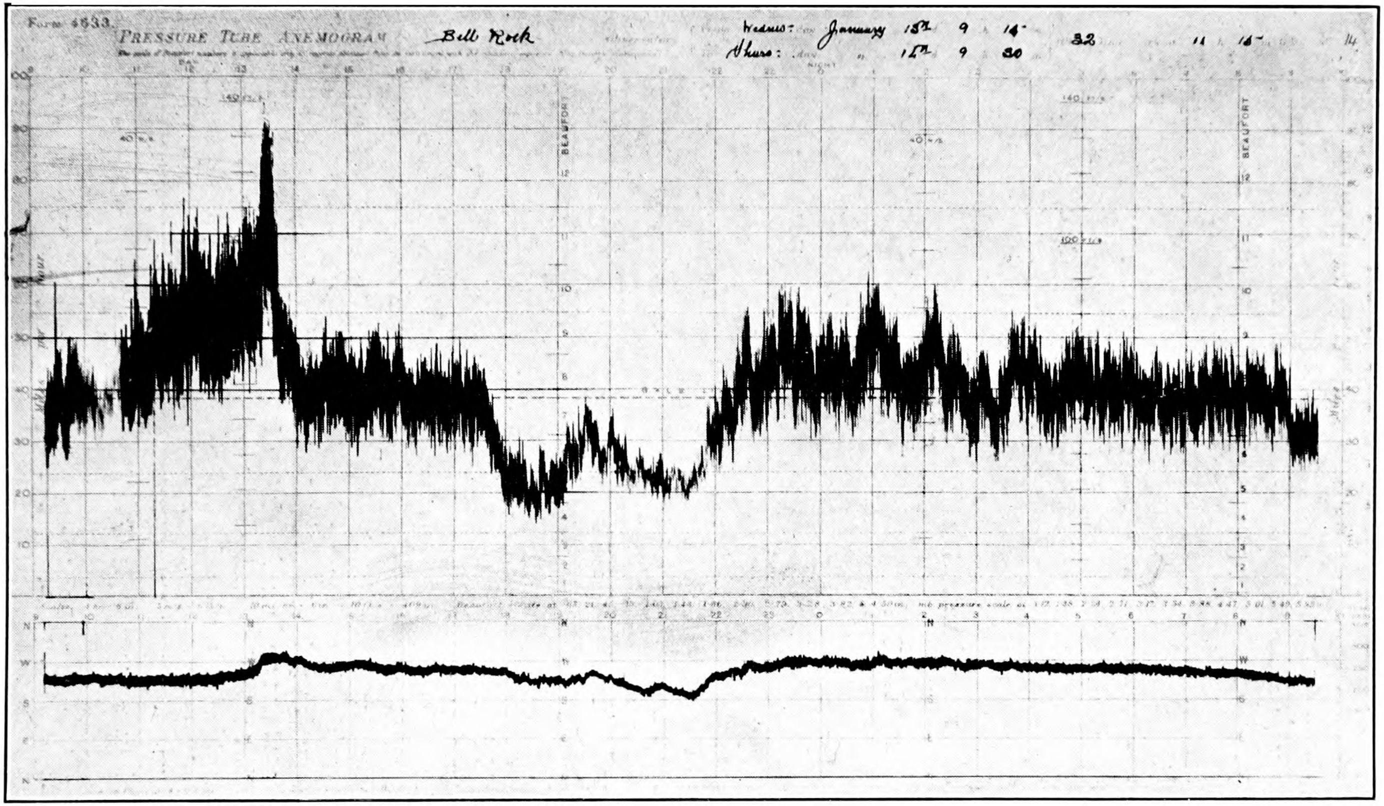
The following note describes the main features of the synoptic situation for north-west Europe on January 13th of this year, for which day the anemogram from the Bell Rock Lighthouse is reproduced here. The lighthouse is situated on an isolated rock about 15 miles east of the entrance to the Firth of Tay, and the anemometer head is 126 feet above mean sea level. For further details of the location reference should be made to this magazine for September, 1929, p. 177.

On the evening of January 12th, an intense depression occupying the north-east Atlantic was centred south of Iceland. This moved north-eastwards during the night, and by mid-day on January 13th the centre was situated just north of Thorshavn. Pressure on the continent was high, so that north-west Europe was under the influence of a strong southerly to south-westerly gradient, as had been the case also for the previous few days. The air passing over the British Isles had followed a long though comparatively rapid track across the Atlantic; air masses of varying stability alternated with one another, according as the air was drawn from higher or lower latitudes on the western Atlantic, so giving rise to a series of fronts or occlusions moving in a north-easterly direction across the British Isles. The temperature was abnormally high for the time of year, even in the less stable types of air.

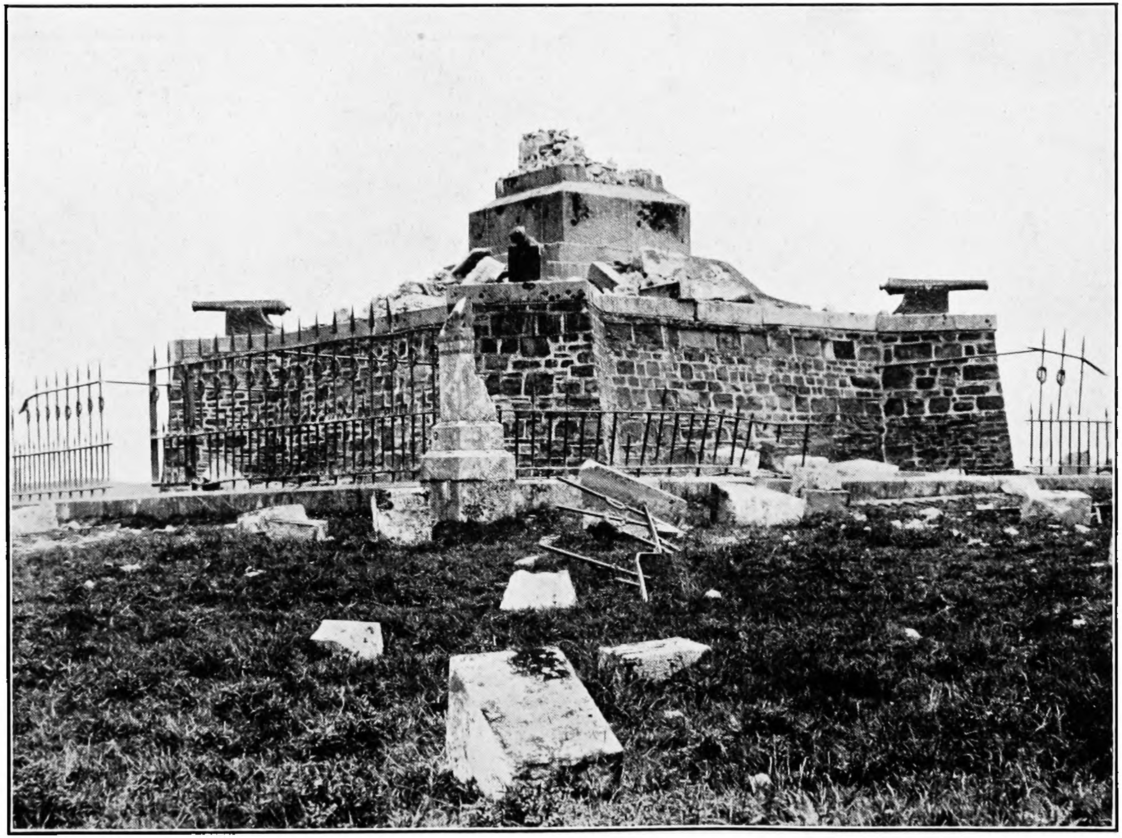
At 7h., January 13th, a narrow warm sector lay over England, from which an occlusion extended northwards through

Scotland and then curled backwards towards western Ireland. By 13h. the main part of this occlusion was approaching the coast of Norway, while the bent-back portion lay over Scotland, passing between Inchkeith and Leuchars, at which station the wind veered from SW. to W. at 13h. 5m. The gradient wind speed at this time in the neighbourhood of these two stations was about 90 m.p.h., so that the remarkably high speeds recorded at Bell Rock betwen 13h. 20m. and 13h. 35m., viz., an average speed of about 75 m.p.h., and gusts up to 95 m.p.h., and the accompanying veer of wind from WSW. to W undoubtedly occurred with the passage of the occlusion. At the same time,


LOW
HIGH
972
976
980
984
988
992
996
1000
1004
1008
1012
1016
1020
1024
1028
Statute Miles.
0 100 200 300 400
13h. G.M.T.
13th January, 1932
Warm Front
Cold Front
Occlusion



ANEMOGRAM, BELL ROCK. TORQUAY, JANUARY 13TH-14TH, 1932.



(*S. R. Dark, Photographer, Bideford.*)

Granite Obelisk shattered by Lightning (*see* p. 136).

as appears from neighbouring stations, the temperature fell a few degrees and pressure began to rise with unusual rapidity, the increase between 13h. and 16h. amounting to 12.2mb. at Leuchars and 10.6mb. at Aberdeen.

Meanwhile the depression continued its north-eastward motion, and by 7h. the next morning there was a series of centres extending from south-west to north-east of Iceland. The lowest pressure for this region recorded on the charts in this period was 960.3mb. at Thorshavn at 10h., January 13th, while it may also be noted that a SW'W. wind of Beaufort force 11 (about 70 m.p.h.) was observed at Lerwick at 18h. of the same day. The average speed of 75 m.p.h. recorded at Bell Rock is equivalent to Beaufort force 10, when allowance is made for the fact that this anemometer is about 90 feet above the standard height.

A. F. Crossley.

Royal Meteorological Society

The last meeting of this Society for the present session was held on Wednesday, June 15th, in the Society's Rooms at 49, Cromwell Road, South Kensington, Prof. S. Chapman, F.R.S., President, in the Chair.

Prof. G. I. Taylor, F.R.S.—The resonance theory of semidiurnal atmospheric oscillations. (*Memoirs, Vol.* 4, *No.* 35.)

The theory that the semidiurnal oscillations in the atmosphere are due chiefly to resonance requires that a free period very close to 12 hours shall exist. Tidal theory shows that the corresponding speed of a free wave is 910 ft. per sec., but direct calculation, and also observations of the Krakatoa air wave agree in giving the velocity of free gravity waves as about 1,050 ft. per sec. It has been suggested that this discrepancy might be explained if rapid pressure changes take place adiabatically, while semidiurnal changes are more nearly isothermal. In the present paper this theory is shown to be untenable, because the radiation or conduction necessary to produce any appreciable difference in the speed of the wave from that appropriate to adiabatic changes would give rise to so much damping that amplification by resonance to the desired extent would be impossible, even if the free period of the atmosphere were exactly 12 hours. The desired resonance, in fact, can only be obtained if the time taken for an inequality of temperature to be reduced by radiation or conduction in the ratio $e : 1$ is greater than 76 hours. The discrepancy between the calculated free period and 12 hours remains unexplained.

H. L. Wright, M.A.—The variation of soil temperature below turf: a discussion of observations at Kew Observatory. (*Memoirs, Val.* 4, *No.* 31.)

The diurnal variation of soil temperature at depths of 10 cm.

and 20 cm. has been analysed. It is found that heat passes from 10 cm. to 20 cm. more rapidly by about one hour and a half than is consistent with the decrease in the ranges of temperature at these depths. The suggestion is advanced that the grass interferes with the normal course of heat conduction. The conduction of heat to a depth of 20 cm. in soil at Kew has been compared with that at Potsdam to an equal depth in a homogeneous stratum of sand. The range of temperature in sand is about twice as great as in loam, and the maximum temperature is reached one hour and a half earlier at Potsdam than at Kew. The diurnal variation of temperature at the " surface " has been deduced by extrapolation. At Potsdam the " surface " temperature becomes a maximum 50 minutes sooner than the air; at Kew the " surface " temperature is a maximum 40 minutes later than the air. It is suggested that the difference, one hour and a half, may represent the time taken to transmit the heat through the grass at Kew.

J. M. Sil (Meteorological Dept., Poona, India).—Variations in potential gradient caused by some meteorological phenomena.

The author has brought together a number of examples of abnormalities in potential gradient and has endeavoured to trace the connexion between them and some meteorological phenomena such as strong insolation, strong wind, the occurrence of a sea breeze, dust storm, &c. The abnormal effect caused by a duststorm was also produced experimentally on a calm day by blowing a small quantity of local dust particles at a point 3 ft. below the collector. The earth's position field in this instance was quickly reversed.

Correspondence

To the Editor, *The Meteorological Magazine.*

Obelisk shattered by Lightning

Through the courtesy of Lady Rosamond A. Christie, of Tapley Park, Instow, N. Devon, we are able to give some details relating to damage caused by a remarkable flash of lightning in a thunderstorm that developed in that neighbourhood in the early morning of June 11th, 1932. The storm was not in other respects a particularly severe one; it developed apparently just in front of the trough separating a cool NW. wind current out on the Atlantic from a belt of southerly winds that prevailed from the western Mediterranean to the seas to the east of Spitsbergen, a shallow cyclonic centre lying at the time west of the Scilly Isles. The flash is described as having been accompanied by a hissing sound. It struck and completely shattered, with an explosive crash, a massive granite obelisk over 50 ft. high standing in an isolated position, which has been a landmark for shipping since it was erected in about 1854. Large blocks of granite were hurled about thirty yards in two directions, but, as will be seen in the photograph facing p. 135, four cannon at the corners of the base of the column were undisturbed.

Storms that just fail to come off

Very interesting are those days in summer when, though there is an obvious threat of showers or storms, these just miss developing except, perhaps, in a very few places because conditions are not quite favourable in the upper air.

Two marked cases occurred in London on June 22nd and 23rd, 1932. June 22nd was a glorious day of wonderful skyscapes, but the somewhat heavy cumulus clouds indicated a tendency for showers that would not mature, yet rain fell that day as near as Sussex and a whirlwind occurred in Hertfordshire.

The next day, June 23rd, went a little further in the direction of storms, though these were still not mentioned in the forecasts. About 6.30 p.m. I noticed intensely black sky over London from Hampstead, and remarked it was just "touch and go." As a matter of fact highly localised hailstorms were developing over Surrey at that time.

L. C. W. Bonacina.

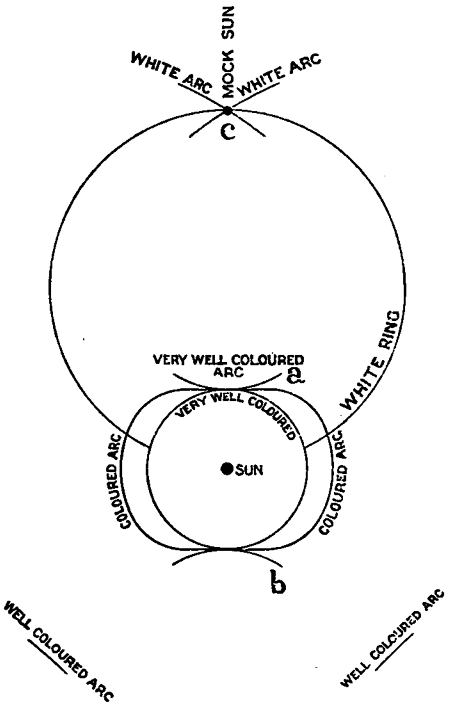
35, *Parliament Hill, Hampstead. June 25th,* 1932.

NOTES AND QUERIES

Halos of May 10th, 1932, at Padstow

A fine halo complex was recorded by two observers on the afternoon of May 10th. Commander H. E. Turner, H.M.S. *Beaufort*, off Padstow, sent the sketch reproduced in the accompanying figure. He remarks on the wonderful colours shown: "At the brightest places the colouring was as distinct and bright as a rainbow . . . and the spectrum could be seen from orange to blue or violet. The sky was slowly clouding over with cirrostratus from the south-westward, and was about 9/10 covered at the time, being only clear in the extreme north-eastward, where there was detached cumulus. . . . The barometer appeared to have reached the top of its upward curve (we were in a wedge of high pressure), and soon afterwards it began to fall." The phenomena were first seen at 14h. 40m. B.S.T., the diameter of the parhelic circle was measured about 15h. 40m., a few minutes before it began to disappear, when the altitude of the sun was approximately 45½°.

Mr. W. M. Lindley, Trevone, Padstow, writes: "On Tuesday, May 10th, 1932, at about 14h. 40m. B.S.T., a solar halo was seen of the normal 22° radius type. This was accompanied by a very strong tangent arc extending all round the halo. My impression was that the outer halo was in the form of an ellipse, with the major axis inclined at some 20° to the horizon and sloping down from south to west. As far as I can remember the maximum radii of the outer halo were in a straight line, though I have since learned that according to theory the halo is not a true ellipse and there should be symmetry about the vertical. I estimated the major axis of the 'ellipse' as $1\frac{1}{4}$ times the diameter of the inner halo.



The horizontal circle (white) was also seen in its entirety from outer halo through countersun to outer halo. No parhelia could be detected in spite of careful search, and only towards the end of the display was a small arc of the 46° halo seen in the west. The sky was almost cloudless and the complete phenomenon was seen until about 15h. 30m. B.S.T., when clouds formed.

The main point of interest was the tangent arc which was most distinct and almost as bright as the main halo, and persisted, easily visible, for the whole time. The horizontal circle cut the ellipse above the end of the major axis in the west. The segments between halo and ellipse were brighter than the inside of the halo, but I could not determine whether they were brighter or fainter than the outside sky. The shade was quite clearly different, but neither by colour nor by intensity could I make judgment. The colours of the tangent arc were those of the halo, but not as sharp (red towards sun).

I have worked out the altitude of the sun at 15h. B.S.T. and it comes out at about 51°."

There are a number of interesting points about this display. The two additional arcs of contact of the 22° halo, marked *a* and *b*, are quite special. The upper one *a* is Parry's upper arc. The lower one, *b*, is presumably the analogous lower arc which occurs in the St. Petersburg halo ("Dictionary of Applied Physics," Vol. III, p. 530). The oblique arcs, *c*, through the anthelion will also be noticed.

Alto-cumulus formed by an aeroplane

On three occasions recently we have experienced at South Farnborough, Hants, a repetition of the above phenomenon, similar to that described in the May, 1931 number of the *Meteorological Magazine.*

On April 21st, 1932, my attention was riveted on a short and very narrow band of white cloud at medium cloud height when F.-Lt. G. H. Stainforth telephoned to inform me that he had witnessed its formation a few minutes earlier. Further, he stated that he had himself formed a similar cloud on April 15th, 1932, and at the same time seen a streak of cloud emanating from another machine well above him. On the third occasion, May 7th, the formation was witnessed by many ground observers as well as by the pilot, who in this case had succeeded in repeating another pilot's unintentional demonstration.

The following brief accounts may be of interest. The first was given by F.-Lt. Stainforth. Unfortunately the pilot of the aeroplane on the second occasion was unaware of his connexion with cloud formation. He has, however, told me his rate of climb which, together with certain angular measurements of the cloud, have enabled me to determine roughly the figures quoted.

1. April 15th, 1932, between 14h. 50m. and 16h. G.M.T.

Cloud formed at 12,000 ft. (altimeter reading) and could be formed within a layer 1-2,000 ft. thick at least, from this height. Appeared as a single stream, which, when seen at close quarters, consisted of a spiral formation. The temperature was 5°F. at 11,480 ft., and 0°F. at 13,380 ft.

2. April 21st, 1932, between 16h. 4m. and 16h. 25m. G.M.T.

Cloud formed at 11,000 ft. within a layer 200-400 ft. thick commencing at this height. Apparently it first appeared as a single dense stream to the south-west of the zenith. When I saw it about four minutes later, then nearly overhead, it had a sharply defined wavy outline. This characteristic was not retained at the leeward end. It was drifting lengthwise with the wind from 230° at a speed of 35 m.p.h. and gradually spreading out fore and aft, developing a filigree pattern somewhat similar to that displayed by a medium height cloud approaching at that time from the south-west. It was finally intercepted by cumulus after being under observation for about twenty minutes, during which time it seemed to be slowly breaking in halves. The temperature was 18°F. at 10,000 ft. and 10°F. at 12,000 ft. (heights uncorrected).

3. May 7th, 1932, at 10h. 10m. G.M.T.

Cloud formed at 9,800 ft. (uncorrected) within a layer 100-200 ft. thick, commencing at 9,800 ft. The pilot had just passed through a thin cloud at about the same height. From the ground two thin elegant streams were observed coming from the machine, resembling cirro-cumulus; after a few seconds they united and formed a billowy alto-cumulus ribbon. This became much wider as it drifted from 320° at a speed of 13 m.p.h., and gradually dispersed. Higher alto-cumulus was also dispersing. Cumulo-nimbus tops close to the region of formation were at about the same level. The pilot reported "no bumps." The temperature at 9,240 ft. was 5°F. and at 10,190 ft. 2·5°F.

F.-Lt. Stainforth's evidence of the phenomenon on April 15th brings to light the probable reason for its formation. He states: "First noticed white 'smoke' against the background of struts; traced it distinctly to the propeller tips; looked back and could see the white trail." On this occasion at least, condensation appears to have originated at or near the propeller where a reduction of pressure is produced on the forward side.* It is at its maximum, I understand, at a point approximately two-thirds the length of the blades from the centre. Vapour may be condensed hereabouts and centrifugal force carry it to the tips, there to be thrown off and carried away in the slip-stream.

If the twin streams, observed temporarily on January 14th, 1931, and again on May 7th, 1932, originated in this way, perhaps the aeroplane's rudder unit was responsible for the division, although why it should occur on one type of machine and not another (all high-powered single-engined biplanes) is not understood. The cloud would be formed as a vortex presumably, and the thickest section seen from below, when the cloud is horizontal, would be along its outer boundary. The middle section is comparatively thin, but one would not expect it to be invisible.

The occasion when F.-Lt. Stainforth saw a machine make a pattern above him—a thin streak like a C, which persisted for at least half an hour—at an altitude of 18,000-25,000 ft., seems to be an ordinary exhaust cloud. The critical temperature for its formation is in the neighbourhood of −40°F. The temperature recorded at South Farnborough during the afternoon of the day in question was −33°F. at 21,220 ft. and −45°F. at 24,820 ft.†

It is not, perhaps, without significance that the air mass on all occasions (with the possible exception of April 15th) has been maritime polar. The weather, apart from January 14th, 1931, has been of the "cool showery" type. The barometric distribution has been similar on all occasions with a low-pressure system over Europe and high pressure to the west.

J. S. SMITH.

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*See *Meteorological Magazine*, 66, 1931, p. 90 (1) (*b*).

†See *Meteorological Magazine*, 61, 1926, p. 116.

Italian upper air investigations

Valuable additions to our knowledge of upper air conditions are being made by the Ufficio Presagi, Rome. Since January, 1930, surface and aerological observations have been made regularly by a station at Cape Guardafui and transmitted by wireless to shipping. Pilot balloon ascents are being made also on board Italian merchant ships between Italy and South America, and meteorograph records are obtained by means of an aeroplane at Montecelio. All these results are discussed in volume IV of the *Annali Ufficio Presagi,* which also contains a study by F. Castriota of " Baric fluctuations and symmetric points for the winter 1930-1931 " over the Atlantic Ocean.

Reviews

Grundriss der Klimakunde. By Prof. Dr. W. Köppen. 2nd revised edition of Die Klimate der Erde. Size $8\frac{1}{2} \times 5\frac{1}{2}$ in., pp. xii. + 388, *Illus.* Berlin and Leipzig, 1931.

Köppen's scheme for the classification of climates, as set out in " Die Klimate der Erde," has proved to be a very convenient shorthand for the rapid description of climates and for the plotting of climatic provinces on charts. It has been employed for the latter purpose in a number of detailed climatological studies and practical use has suggested some minor improvements which are embodied in a new edition. Further, some new sections have been added to make the book more complete as a text-book of climatology, a function which is indicated by the change of title.

The general scheme of the classification is briefly as follows: The world is first divided according to the distribution of temperature and rainfall into a series of major zones or provinces; A, a tropical zone of uniformly high temperature; B, two subtropical arid zones; C, two warm-temperate zones; D, a cold temperate or " boreal " province which is found only in the northern hemisphere; E, zones of cold climate or tundras beyond the limit of tree-growth, and F, the climate of eternal frost (warmest month below freezing point) found only in Greenland and Antarctica. These major zones are then sub-divided according to the type of climate within the zone, each peculiarity being given a characteristic letter, such as *w*, winter dry season, *n*, frequent fog (Nebel), *S*, steppe climate, *W*, desert (Wüst). Most of these characteristics are defined numerically, so that the main features of the climate of any region can be set down with the brevity and something of the exactness of a chemical formula.

The most important change from the first edition is in the definitions of steppe and desert climates. These depend on the balance of rainfall and evaporation, and the most convenient measure of the latter is the mean temperature of the year, or of the season in which the greater part of the rain falls, but the form of the expression has been altered slightly and the criteria of desert and steppe are made far more rigorous, especially in a cold climate. They may even be too rigorous, for a region with a mean annual temperature of 50°F. and a rainfall of just over 4 inches a year falling mainly in the winter months is now regarded as steppe and not as desert. R. J. Russell,* investigating the application of Köppen's formulæ to the dry regions of the United States, apparently considers that the best criterion of desert would be somewhere between the old and new formulæ, a conclusion with which the reviewer is disposed to agree.

Another important change in the new edition is shown in the frontispiece map, which is now printed in colours and is on Mercator's projection instead of Mollweide's. The appearance of the map is greatly improved, and the colours facilitate easy reference, but a large amount of detail has been sacrificed by omitting the climatic formulæ which were a most useful feature of the earlier map. Thus a great belt from central Europe and Scandinavia to central Siberia now appears in a uniform tint denoting a "moist-winter cold climate"; formerly this large region was sub-divided into sections with five or more months above 10°C. and with less than five months above 10°C., an important distinction for agricultural purposes. Again, in the new chart the region of the southern Sahara, for example, appears simply as "Steppe," but in the old chart as B S h w t, which means a hot steppe climate with the dry season in winter and the highest temperatures in the autumn—a far more encyclopædic description.

The tables, which are in a very condensed form and yet occupy 70 pages, are a feature of very great value, containing the essential climatic data for more than one thousand stations. An index has been added for the purposes of reference, and the whole work forms an excellently compact summary of existing knowledge of the earth's climate.

Our Natural Water Supply. By J. D. Schonken, B.A. Size $7\frac{1}{4} \times 5$, pp. 38, and *Plant life and the siccation process.* By J. D. Schonken, B.Sc., M.D., S. Afric., J. Sci., 28, 1931, pp. 238-45.

The influence of a forest covering on climate and run-off is a vital question in South Africa, and Dr. Schonken throws himself whole-heartedly into the discussion. He classifies countries according to their "climatic status," which is their natural relative humidity derived from extraneous sources. Where the relative humidity is naturally high, as in Great Britain, deforestation has no appreciable effect on the climate, but where little moisture penetrates from surrounding oceans, as in South Africa, he regards the maintenance of a transpiring forest cover as essential. While he recognises that even in these countries deforestation has very little effect on the actual amount of rain which falls in a year, he considers that it has a markedly harmful effect in increasing the irregularity of the rain and also in drying out the air and the soil. Still greater is its effect in promoting the washing away of the soil and in converting clear perennial streams into muddy occasional torrents. Hence, South Africa must afforest on a large scale or face ruin. Although the first of these two papers, which is a translation of two lectures delivered at Stellenbosch University, is frankly polemical, it is very persuasive and makes powerful use of the facts of history.

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*Dry climates in the United States. Univ. California Publ. Geogr. 5, No. 1, Berkeley. 1931.

India Meteorological Department, Scientific Notes. Vol. III, No. 26. *Some statistical relations of temperature and pressure in the upper atmosphere over Agra* (1926-29) *and Batavia* (1910-15). By S. Gopal Ras, B.A.; and Vol. III, *No.* 28: *Horizontal gradients of pressure and temperature in the upper atmosphere over India calculated from pilot balloon ascents.* By A. Narayanan, M.A.

Both these papers are valuable contributions to our knowledge of the atmosphere over India. The first gives standard deviations and correlation coefficients between pressure and temperature at fixed heights, and the second gives horizontal gradients of pressure and temperature, deduced by well-known methods from the variation of wind with height, on the assumption of "geostrophic" motion. In the winter half-year there are westerly upper winds, increasing upwards, and hence the temperature decreases to northwards. The computed gradient is steep between 4 and 9 Km. over northern India, as much as 1°C. per 100 Km. at Simla, while at Bangalore, in southern India, it is only 0.2°C. per 100 Km. Over Agra at this season the correlation coefficient between pressure and temperature is large from 2 to 8 Km., and remains positive up to 12 Km. The standard deviation of pressure is considerably lower at all heights than it is in England in all seasons, and the figures for temperature are also lower, except from 8 to 10 Km., where they are roughly similar.

In summer the conditions are different, and during the monsoon from June to September the temperature on the whole falls towards the south. Below 5 Km. and above 10 Km. the highest temperature is somewhere north of Simla, while between 5 and 10 Km. it is between Agra and Poona. Sounding balloons have shown that in July and August the upper air temperature is higher over Agra than over Batavia, owing to the heat set free by condensation in the monsoon. The correlation coefficient between temperature and pressure is negligible during the monsoon up to 4 Km., and is only high between 9 and 14 Km. The standard deviation of temperature above 2 Km. has only about half its winter value. Over Batavia the relationships are on the whole similar to those over India during the monsoon, which are thus essentially of tropical type.

The correlation coefficient between the pressure at the surface and at 9 Km. at Agra is − 0.67 for the whole year, owing to seasonal influence, but is negligible for the winter and monsoon seasons considered separately.

C. K. M. DOUGLAS.

India Meteorological Department, Scientific Notes. Vol. IV, No. 42. *A discussion of monthly mean values of upper air temperatures and humidities obtained from aeroplane ascents at Peshawar and Quetta.* By A. Narayanan, M.A., Calcutta, 1931.

This paper is an analysis of the results of observation of pressure and temperature made from R.A.F. aeroplanes. It is based on some 700 flights made at or near Peshawar during the three years 1927-9, and some 500 flights made from Quetta during the three years ending May, 1930. In both cases all the flights used were made in the morning.

The paper describes the method of observation in some detail, and it is evident that considerable care was taken to insure the accuracy of the data obtained. The latter is presented in the form of numerous tables and graphs, and provides a mass of information useful for future reference. The region of the atmosphere covered is from the surface up to 4.5 Km. at Peshawar and up to 4 Km. at Quetta.

On one point more information would have been welcome. The tables of relative humidity include cases in which the mean temperature was considerably below freezing, in one case the mean was as low as 6°F. There is, however, no indication of how the relative humidity was measured under such circumstances; the equipment described (dry and wet strut thermometers) is quite inadequate for measuring relative humidity at such low temperatures.

The Indian Meteorological Department are to be congratulated on the steady additions which they are making to our knowledge of the upper atmosphere over India.

L. H. G. DINES.

Annales de l'Observatoire National d'Athènes. Published by D. Eginitis. Tome XI, Athens, 1931.

In accordance with the usual practice, this volume contains, besides summaries of astronomical and meteorological observations, a number of papers on geophysical and meteorological subjects. Professor Eginitis, Director of the Observatory, contributes an extensive study of the peculiar tidal phenomena in the Strait of Euripus which have presented a problem to various investigators from Aristotle onwards.

In "Sur les causes des mouvements microsismiques réguliers du sol d'une periode de 4s.—8s. à Athènes," N. A. Critikos attributes these particular microseisms to the action of the prevailing northerly winds on the land masses.

The meteorological papers include a note on the climate of Zante by A. N. Livathinos, and a study of evaporation at Athens by Th. Findiklis. In the last-mentioned paper is discussed a homogeneous set of observations with a Piché evaporimeter from 1894 to 1928. The normal depth of water evaporated annually at Athens according to these observations is 1,600 mm. (64 inches).

The astronomical and meteorological summaries cover the period 1927-9.

S. T. A. MIRRLEES.

Average number of rain-days in Java and Madoera during the four consecutive for every station driest months of the year. By Prof. Dr. J. Boerema. Kon. Magn. Meteor. Obs. Batavia. Verh. No. 23. Size 10½ x 7¼in., pp. 25 + map. English summary, Batavia, 1931.

The publication gives statistics of the mean number of rain-days during the four driest consecutive months of the year, at some 2,500 stations in Java and Madoera. A map is also given on a scale of 1 to 1,200,000 (19 miles to 1in.).

Maps of the mean annual and monthly rainfall and of the positions of the various stations have already been given in Verh. No. 14, while the distribution of the average monthly rainfall throughout the year was given in Verh. No. 18. In the review of the latter publication* details were given of the causes of the dry and wet seasons.

In practically the whole of this area the driest four months occur with the south-east monsoon, which travels for a much shorter distance over the sea than does the north-west monsoon. The number of rain-days in the driest four mouths decreases generally from west to east and from south to north. The number varies from just over 80, in the mountainous regions to the south of Batavia, to rather less than 5 along coastal strips in the extreme north-east of Madoera and Java. The decrease to the east is connected with the increasing dryness of the south-east monsoon towards Australia. The most striking droughts occur when the south-east monsoon crosses a mountain-ridge and descends into the plain as a föhn-like wind.

J. GLASSPOOLE.

**Meteorological Magazine*, 62, 1927. *p.* 194.

Books Received

Bulletin de l'Observatoire de Talence (Gironde). 2nd Series, Nos. 15-18, Talence, 1931.

Royal Alfred Observatory, Mauritius. Results of magnetical and meteorological observations for September to December, 1930, and January to June, 1931; Port Louis, 1930 and 1931.

The Structure of the Sea-Breeze at Poona, by K. R. Ramanathan, M.A., D.Sc. India Meteor. Dept., Sci. Notes, Vol. III, No. 30.

The Lunar Atmospheric Tide at Kodaikanal and Periyakulam, by S. K. Pramanik, M.Sc., S. C. Chatterjee, B.Sc., and P. P. Joshi, B.Sc. India Meteor. Dept., Sci. Notes, Vol. IV, No. 31.

Obituary

Robert Bessel Sargeant.—We regret to learn of the death of Mr. R. B. Sargeant at his home in Lancing on June 25th. Mr. Sargeant was born on May 28th, 1856, and entered the Meteorological Office in November, 1871, at the age of fifteen, being attached to the "Telegraph" department, as the forecasting service was then termed. He was associated with this division during the greater part of his career, and in 1901 he became one of the officers in charge of the issue of forecasts and gale warnings. During the war, when forecasting duties became very arduous and responsible, while the cessation of many reports added to the difficulties, Mr. Sargeant was our most experienced forecaster, and those who had to learn their work under war conditions owe much to his kindly help. He met the most difficult or critical situations with an unhesitating confidence which was a splendid example to his younger colleagues. His knowledge of past weather situations, when he could be brought to display it—for he was the most unassuming of men—was amazing. In 1920 he became Assistant Superintendent in the Forecasting Division, and helped to train the post-war generation of forecasters. He retired on March 1st, 1922, after more than fifty years of continuous service.

William Gardner Reed.—We regret to learn of the death of Mr. W. G. Reed on March 30th, 1932. Mr. Reed studied meteorology at Harvard, where he was awarded the A.M. degree for a study of the cyclonic distribution of rainfall in the United States, which was published in the *Monthly Weather Review* in 1911. From Harvard he went to the University of California as instructor in meteorology, but after a few years he joined the climatic section of the Atlas of American Agriculture under the U.S. Department of Agriculture, where he became specially interested in the frost hazard in farming. His papers on this subject were much appreciated, and after the frost folio of the

Atlas was completed, he transferred to the Weather Bureau and specialised in fruit frost forecasting in Utah.

We regret to learn of the death, on December 21st, 1931, in his ninety-first year, of Dr. Daniel Draper, for more than 42 years official meteorologist for the City of New York.

News in Brief

Mr. H. Jameson, M.Sc., F.Inst.P., has been appointed Director of Colombo Observatory, Ceylon, in succession to Mr. A. J. Bamford, who has retired.

Professor Dr. H. Hergesell retired on April 1st from the Directorship of Lindenberg Aeronautical Observatory, which he has held since May 1st, 1914.

We learn from *Nature* that a scientific institute has recently been established in Moscow to carry on research on the circumstances of formation of cloud, fog and rainfall. The institute has branches in Leningrad, Odessa, Saratov, Tashkent and Askhabad.

The Weather of June, 1932

Except for parts of Sweden pressure was above normal in a belt extending from Russia across the British Isles and North Atlantic to north-west Canada and from Russia across south-east Europe and Italy to north Africa and south Spain and also over Bermuda and California; the excess reached 5·7mb. at Julianehaab. Pressure was below normal over France, Switzerland, north Spain and across the Azores and Nova Scotia to the United States and west and south-east Canada. Temperature was generally below normal except at Spitsbergen where it was above normal. Rainfall was deficient except in Spitsbergen and parts of Sweden; in the coastal districts of northern Norrland it was 90 per cent. above normal, but in Scania it was only one-third of the normal.

Over the British Isles, June, 1932, in contrast to May, was unusually dry up to the 27th, and in some parts sunny. There were absolute droughts of 29 days at Cheltenham from May 30 to June 27, and of 28 days at Harrogate and Dunbar from May 30 to June 26 and May 29 to June 25 respectively. At the beginning of the month an area of high pressure over Greenland and Iceland extended over the northern part of the British Isles; the 2nd was generally sunny and high day temperatures were recorded in western Scotland, but the eastern districts were cooler. A depression on the Atlantic moving south-east caused heavy rain locally on the 3rd on the south coast and Channel Isles. On the 4th polar air coming down the North Sea caused cool weather; maximum day temperatures were low in many places, notably 50° at Lympne and 51° at Plymouth and Leafield. The anticyclone over Iceland then moved southward and finally eastward, and temperature gradually rose; good sunshine records were obtained on the 9th and 11th, and high day temperatures were recorded on the 11th in eastern England. From the 10th to 11th a shallow trough of low pressure crossed the British Isles and thunderstorms occurred locally on the 11th. On the 12th an anticyclone south-west of Iceland moved eastwards over the British Isles, and later the Azores anticyclone extended north-east and a spell of dry sunny weather occurred generally, though there was some rain with thunder in Ireland. Day temperatures were high in western Scotland, 80° being reached at Renfrew on the 17th. About the 19th a depression spread eastwards from the Baltic causing an incursion of cool air from the North Sea, day temperatures were low on the 19th and 20th but little rain fell, and there was good sunshine in parts of the west and south. From the 21st most of the British Isles came under the influence of an anticyclone to the south-west of Ireland and temperatures rose; depressions, however, crossing Iceland rendered the weather in northern districts somewhat unsettled. The fair spell broke in England on the 27th, when a secondary trough to a deep depression near the Faroes moved across the country; heavy rain and thunderstorms occurred locally on the 27th and 28th. In front of a depression west of Ireland, heavy rain fell in the south-west on the 29th and spread to all districts on the 30th. Many stations recorded more than an inch of rain on the 30th and some stations more than 3 inches—notably Holne, Devon, 3·28 in.; S. Brent, Devon, 3·70 in.; St. Briavels, Glos., 3·20 in.; Llyn Fawr, Glamorgan, 3·16 in.; and Treherbert, Glamorgan, 3·15 in. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	166	—12	Liverpool	212	+12
Aberdeen	175	— 9	Ross-on-Wye	227	+30
Dublin	209	+20	Falmouth	266	+45
Birr Castle	188	+24	Gorleston	183	—27
Valentia	187	— 1	Kew	211	+14

The special message from Brazil states that the rainfall was irregular with 0·16in. above normal in the northern regions, 0·08in. above normal in the central regions and 0·51in. below normal in the southern regions. Crops generally in good condition except in Sao Paulo and Minas the coffee crop was suffering from excessive rains. Four anticyclones passed across the country. At Rio de Janeiro pressure was 1·2mb. below normal and temperature 0·4°F. above normal.

Miscellaneous notes on weather abroad culled from various sources.
Eighty people were killed and 80 injured in a hurricane which struck the town of Ismail, Roumania on the 2nd. In consequence of the heavy rains extensive floods occurred in Swedish Lapland at the beginning of the month. A hailstorm swept across the Jura region on the night of the 2nd and destroyed vineyards along Lake Neuchatel; the following day there was a cloud-burst over Oppenheim on the Rhine, which wrought havoc with the vineyards of that district. Snow fell in Bologna and Tuscany on the 24th, and hail along the Italian Riviera, while storms were experienced in Venice and Trieste. Torrential rain and hail fell in Moldavia and Bukovina on the 25th and 26th, followed by floods; some 30 people were drowned. Towards the end of the month violent storms in the mountainous regions of Portugal destroyed many crops and vineyards, and snow fell in the Bavarian Allgäu in south Germany as low as 4,500 ft. above sea level, which is very unusual in June. (*The Times*, June 3rd-29th.)

About the 8th, the monsoon was said to be reviving in the south-east of the Arabian Sea; it reached Bombay on the night of the 19th, when nearly 4 in. of rain fell. A storm of great severity passed over Jubbulpore on the 11th, killing 3 people. Deaths from heat were reported from many parts of northern India during the month. The monsoon arrived late in Burma and the rainfall was small. The Arabian Sea monsoon was active over the Central and United Provinces during the latter part of the month. (*The Times*, June 9th-24th.)

At the beginning of the month widespread rains, up to 1½ in., fell west of a line from Cloncurry to Brisbane, and also general rains over the agricultural areas of Western Australia. Soaking rains occurred over the whole agricultural area of South Australia during the 11th-12th. (*The Times*, June 7th-14th.)

Unprecedented cold with gales, fog and snow occurred off Newfoundland early in the month. Weather conditionns were good for the crops generally in Canada during the month. In the United States the temperature was variable and the rainfall deficient generally at first, but later in excess except in the Lake Region, Mountain Region, and the Pacific Coast. Good rains fell in parts of Buenos Aires, Cordoba and Sante Fé about the middle of the month. Bad weather prevailed in Montevideo about the 25th and the port was closed. (*The Times*, June 4th-29th, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Rainfall, June, 1932—General Distribution

England and Wales	59	per cent of the average 1881-1915.
Scotland	49	
Ireland	60	
British Isles	57	

Rainfall : June, 1932 : England and Wales.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square	·70	35	*Leics* .	Belvoir Castle...........	1·48	78
Sur .	Reigate, Alvington ...	1·68	81	*Rut* .	Ridlington	·46	24
Kent .	Tenterden, Ashenden...	1·39	73	*Lincs* .	Boston, Skirbeck......	·40	22
,, .	Folkestone, Boro. San .	1·48	...	,,	Cranwell Aerodrome ...	·41	24
,, .	Margate, Cliftonville...	·53	30	,, .	Skegness, Marine Gdns	·65	36
,, .	Sevenoaks, Speldhurst	1·26	...	,, .	Louth, Westgate	·38	18
Sus .	Patching Farm	1·72	85	,, .	Brigg, Wrawby St. ...	·57	...
,, .	Brighton, Old Steyne..	1·30	72	*Notts* .	Worksop, Hodsock ...	·66	33
,, .	Heathfield, Barklye ...	1·72	82	*Derby* .	Derby, L. M. & S. Rly.	·94	42
Hants.	Ventnor, Roy. Nat. Hos.	2·16	118	,, .	Buxton, Devon Hos. ...	1·06	33
,, .	Fordingbridge, Oaklnds	2·25	122	*Ches* .	Runcorn, Weston Pt...	·35	14
,, .	Ovington Rectory	2·34	101	,, .	Nantwich, Dorfold Hall	·63	...
,, .	Sherborne St. John ...	1·55	73	*Lancs*.	Manchester, Whit Pk.	·35	13
Berks .	Wellington College ...	1·13	52	,, .	Stonyhurst College ...	·99	32
,, .	Newbury, Greenham...	1·59	73	,, .	Southport, Hesketh Pk	·68	31
Herts .	Welwyn Garden City...	·75	...	,, .	Lancaster, Strathspey	1·86	...
Bucks.	H. Wycombe, Flackwell	·80	...	*Yorks*.	Wath-upon-Dearne ...	·47	21
Oxf .	Oxford, Mag. College...	·52	24	,, .	Bradford, Lister Pk. ...	·57	24
Nor .	Pitsford, Sedgebrook...	·66	34	,, .	Oughtershaw Hall	2·93	...
,, .	Oundle....................	·33	...	,, .	Wetherby, Ribston H.	·44	21
Beds .	Woburn, Crawley Mill	·67	34	,, .	Hull, Pearson Park ...	...	...
Cam .	Cambridge, Bot. Gdns.	...	...	,, .	Holme-on-Spalding ...	·49	...
Essex .	Chelmsford, County Lab	·59	31	,, .	West Witton, Ivy Ho.	1·75	86
,, .	Lexden Hill House ...	·47	...	,, .	Felixkirk, Mt. St. John	1·00	46
Suff .	Haughley House.........	·45	...	,, .	Pickering, Hungate ...	·62	29
,, .	Campsea Ashe...........	·42	22	,, .	Scarborough	·43	23
Norf .	Norwich, Eaton.........	...	...	,, .	Middlesbrough	·94	50
,, .	Wells, Holkham Hall	·39	20	,, .	Balderdale, Hury Res.	1·15	...
,, .	Swaffham, The Villa...	·68	31	*Durh* .	Ushaw College	1·08	50
Wilts.	Devizes, Highclere......	1·19	53	*Nor* .	Newcastle, Town Moor	·72	33
,, .	Bishops Cannings	1·34	55	,, .	Bellingham, Highgreen	1·34	58
Dor .	Evershot, Melbury Ho.	3·29	144	,, .	Lilburn Tower Gdns...	1·84	89
,, .	Creech Grange	2·67	116	*Cumb* .	Geltsdale.................	1·26	...
,, .	Shaftesbury, Abbey Ho.	·70	30	,, .	Carlisle, Scaleby Hall	·95	38
Devon.	Plymouth, The Hoe...	3·56	165	,, .	Borrowdale, Seathwaite	5·25	86
,, .	Launceston, Werringt'n	3·09	...	,, .	Borrowdale, Moraine...	4·67	...
,, .	Holne, Church Pk. Cott.	5·32	185	,, .	Keswick, High Hill...	2·25	...
,, .	Cullompton..............	1·73	82	*West* .	Appleby, Castle Bank	2·25	98
,, .	Sidmouth, Sidmount...	2·80	133	*Glam* .	Cardiff, Ely P. Stn. ...	1·55	62
,, .	Filleigh, Castle Hill ...	1·25	...	,, .	Treherbert, Tynywaun	3·94	...
,, .	Barnstaple, N. Dev. Ath	·85	38	*Carm* .	Carmarthen Friary ...	2·87	100
,, .	Dartm'r, Cranmere Pool	4·60	...	*Pemb* .	Haverfordwest, School	2·45	91
Corn .	Redruth, Trewirgie ...	3·48	140	*Card* .	Aberystwyth	1·18	...
,, .	Penzance, Morrab Gdn.	3·01	136	,, .	Cardigan, County Sch.	1·73	...
,, .	St. Austell, Trevarna...	2·87	110	*Brec* .	Crickhowell, Talymaes	2·00	...
Soms .	Chewton Mendip	1·79	60	*Rad* .	Birm W.W. Tyrmynydd	1·99	61
,, .	Long Ashton	1·42	56	*Mont* .	Lake Vyrnwy...........	1·68	53
,, .	Street, Millfield.........	1·09	51	*Denb* .	Llangynhafal	·76	36
Glos .	Blockley	1·37	...	*Mer* .	Dolgelly, Bryntirion...	2·03	58
,, .	Cirencester, Gwynfa ...	1·26	53	*Carn* .	Llandudno	·96	47
Here .	Ross, Birchlea...........	1·68	77	,, .	Snowdon, L. Llydaw 9	5·40	...
,, .	Ledbury, Underdown..	1·31	58	*Ang* .	Holyhead, Salt Island	1·40	65
Salop .	Church Stretton.........	1·16	48	,, .	Lligwy.....................	1·21	...
,, .	Shifnal, Hatton Grange	·72	32	*Isle of Man*			
Worc .	Ombersley, Holt Lock	·82	36		Douglas, Boro' Cem. ...	2·19	89
War .	Birminghm, Edgbaston	1·66	72	*Guernsey*			
Leics .	Thornton Reservoir ...	1·26	58		St. Peter P't. Grange Rd.	1·33	72

Rainfall: June, 1932: Scotland and Ireland.

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Wigt .	Pt. William, Monreith	1·25	53	*Suth* .	Melvich	·49	...
,, .	New Luce School	1·72	60	,, .	Loch More, Achfary	1·73	47
Kirk .	Carsphairn, Shiel	2·71	68	*Caith* .	Wick	·65	36
Dumf .	Dumfries, Crichton, R.I	1·93	...	*Ork* .	Pomona, Deerness	1·00	54
,, .	Eskdalemuir Obs.	1·38	44	*Shet* .	Lerwick	1·50	84
Roxb .	Branxholm	1·49	66	*Cork* .	Caheragh Rectory	1·56	...
Selk .	Ettrick Manse	1·47	41	,, .	Dunmanway Rectory	2·46	70
Peeb .	West Linton	1·20	...	,, .	Ballinacurra	1·62	62
Berw .	Marchmont House	1·42	61	,, .	Glanmire, Lota Lo.	1·68	62
E.Lot .	North Berwick Res.	1·08	65	*Kerry* .	Valentia Obsy	2·95	92
Midl .	Edinburgh, Roy. Obs.	1·00	50	,, .	Gearahameen	3·50	...
Lan .	Auchtyfardle	2·00	...	,, .	Killarney Asylum	2·60	89
Ayr .	Kilmarnock, Kay Pk.	1·42	...	,, .	Darrynane Abbey	2·55	81
,, .	Girvan, Pinmore	1·99	69	*Wat* .	Waterford, Gortmore	2·14	82
Renf .	Glasgow, Queen's Pk.	·98	42	*Tip* .	Nenagh, Cas. Lough	1·49	61
,, .	Greenock, Prospect H.	1·76	53	,, .	Roscrea, Timoney Park	1·31	...
Bute .	Rothesay, Ardencraig.	1·83	60	,, .	Cashel, Ballinamona	1·04	45
,, .	Dougarie Lodge	1·64	...	*Lim* .	Foynes, Coolnanes	1·57	61
Arg .	Ardgour House	2·10	...	,, .	Castleconnel Rec.	·64	...
,, .	Glen Etive	1·88	40	*Clare* .	Inagh, Mount Callan	2·35	...
,, .	Oban	1·08	36	,, .	Broadford, Hurdlest'n.	1·14	...
,, .	Poltalloch	2·11	70	*Wexf* .	Gorey, Courtown Ho.	1·36	56
,, .	Inveraray Castle	1·71	43	*Kilk* .	Kilkenny Castle	1·63	67
,, .	Islay, Eallabus	1·88	72	*Wick* .	Rathnew, Clonmannon	1·29	...
,, .	Mull, Benmore	6·40	...	*Carl* .	Hacketstown Rectory	1·53	55
,, .	Tiree	1·90	...	*Leix* .	Blandsfort House	1·48	57
Kinr .	Loch Leven Sluice	1·60	73	,, .	Mountmellick	·99	...
Perth .	Loch Dhu	2·60	62	*Offaly* .	Birr Castle	·56	24
,, .	Balquhidder, Stronvar	1·85	...	*Kild'r* .	Monasterevin	...	...
,, .	Crieff, Strathearn Hyd.	1·15	44	*Dublin*	Dublin, FitzWm. Sq.	·36	18
,, .	Blair Castle Gardens	·73	37	,, .	Balbriggan, Ardgillan.	1·17	58
Angus .	Kettins School	·93	50	*Meath* .	Beauparc, St. Cloud	1·04	...
,, .	Dundee, E. Necropolis	·95	53	,, .	Kells, Headfort	1·20	45
,, .	Pearsie House	1·20	...	*W.M* .	Moate, Coolatore	1·20	...
,, .	Montrose, Sunnyside	.99	60	,, .	Mullingar, Belvedere	1·05	40
Aber .	Braemar, Bank	1·17	60	*Long* .	Castle Forbes Gdns.	·67	26
,, .	Logie Coldstone Sch.	·63	32	*Gal* .	Ballynahinch Castle	2·71	77
,, .	Aberdeen, King's Coll.	1·13	66	,, .	Galway, Grammar Sch.	2·52	...
,, .	Fyvie Castle	·93	44	*Mayo* .	Mallaranny	4·07	...
Moray .	Gordon Castle	·29	14	,, .	Westport House	2·70	100
,, .	Grantown-on-Spey	...	...	,, .	Delphi Lodge	5·46	95
Nairn .	Nairn	·10	6	*Sligo* .	Markree Obsy	2·32	79
Inv's .	Ben Alder Lodge	·77	...	*Cavan* .	Belturbet, Cloverhill	·80	33
,, .	Kingussie, The Birches	·55	...	*Ferm* .	Enniskillen, Portora	1·42	...
,, .	Loch Quoich, Loan	2·05	...	*Arm* .	Armagh Obsy	·85	34
,, .	Glenquoich	2·55	52	*Down* .	Fofanny Reservoir	5·80	...
,, .	Inverness, Culduthel R.	·22	...	,, .	Seaforde	1·77	64
,, .	Arisaig, Faire-na-Squir	1·39	...	,, .	Donaghadee, C. Stn.	1·29	55
,, .	Fort William, Glasdrum	·92	...	,, .	Banbridge, Milltown	1·33	...
,, .	Skye, Dunvegan	2·96	...	*Antr* .	Belfast, Cavehill Rd.	1·59	...
,, .	Barra, Skallary	1·86	...	,, .	Glenarm Castle	2·50	...
R & C .	Alness, Ardross Castle	·55	24	,, .	Ballymena, Harryville	2·32	80
,, .	Ullapool	·74	31	*Lon* .	Londonderry, Creggan	1·36	48
,, .	Achnashellach	1·92	...	*Tyr* .	Omagh, Edenfel	1·67	59
,, .	Stornoway	1·56	...	*Don* .	Malin Head	1·10	...
Suth .	Lairg	·26	13	,, .	Dunfanaghy	1·13	...
,, .	Tongue	·63	31	,, .	Killybegs, Rockmount.	1·71	45

Climatological Table for the British Empire, January, 1932

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb							
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1023·1	+ 5·5	56	22	48·4	38·8	43·6	+ 4·7	40·9	91	7·7	1·61	— 0·15	12	1·2	15
Gibraltar	1027·2	+ 6·0	68	38	61·3	49·7	55·5	+ 0·7	49·3	81	6·5	2·75	— 2·31	10	..	..
Malta	1025·3	+ 8·3	63	45	57·7	49·6	53·7	— 1·6	49·6	77	5·7	2·67	— 0·54	10	6·2	62
St. Helena	1013·5	+ 0·6	70	57	67·1	58·9	63·0	— 1·0	59·9	95	9·4	1·65	..	20	..	..
Sierra Leone	1012·6	+ 1·8	91	67	85·1	72·9	79·0	— 2·3	70·2	67	3·2	1·05	+ 0·64	1	..	..
Lagos, Nigeria	1010·5	+ 0·9	90	68	86·8	71·9	79·3	— 1·6	68·9	71	2·5	0·02	— 1·02	1	3·7	32
Kaduna, Nigeria	1013·6	— 1·1	96	55	87·2	57·8	72·5	— 0·9	54·0	30	1·3	0·00	0·00	0	8·4	73
Zomba, Nyasaland	1008·3	+ 0·9	90	57	81·8	64·1	72·9	+ 0·1	..	82	7·1	9·23	— 1·87	15	..	..
Salisbury, Rhodesia	1010·9	+ 0·2	86	51	79·7	60·0	69·9	+ 0·2	63·0	69	6·9	5·15	— 2·17	15	6·1	47
Cape Town	1015·5	+ 2·1	94	51	78·0	59·9	68·9	— 1·0	60·2	60	2·9	0·45	— 0·23	4	..	..
Johannesburg	1009·7	+ 0·2	88	44	78·5	55·7	67·1	+ 0·4	57·4	64	4.2	3·67	— 2·50	11	9·8	72
Mauritius	1012·0	+ 0·1	88	69	85·5	73·4	79·4	+ 0·1	75·7	73	6·8	7·63	— 0·13	22	7·5	57
Calcutta, Alipore Obsy.	1017·0	+ 1·8	86	51	80·9	58·9	69·9	+ 3·3	60·1	91	1·5	0·00	— 0·42	0*	..	..
Bombay	1015·0	+ 1·4	93	67	88·2	69·2	78·7	+ 3·2	67·6	77	1·4	0·00	— 0·10	0*	..	..
Madras	1016·1	+ 2·0	85	64	83·4	67·6	75·5	— 0·7	69·3	81	3·5	0·00	— 1·14	0*	..	..
Colombo, Ceylon	1012·3	+ 1·5	94	69	89·0	71·7	80·3	+ 0·8	72·6	70	2·4	0·00	— 3·25	0	8·8	75
Singapore	..	..	90	69	84·9	71·9	78·4	— 1·3	74·2	79	7·0	6·52	— 3·37	15	5·7	47
Hongkong	1022·9	+ 3·2	74	43	65·7	56·0	60·9	+ 0·7	54·2	64	3·9	0·00	— 1·32	0	7·1	65
Sandakan	..	..	86	71	84·8	74·5	79·7	— 0·1	75·9	83	..	11·22	— 8·18	20	..	..
Sydney, N.S.W.	1011·6	— 0·8	106	57	79·1	66·2	72·7	+ 1·1	67·3	71	8·1	0·25	— 3·42	2	6·6	47
Melbourne	1012·1	— 0·8	109	51	81·4	57·0	69·2	+ 1·8	59·2	52	4·7	0·01	— 1·88	1	7·3	50
Adelaide	1012·2	— 0·8	110	53	91·8	64·3	78·1	+ 4·2	61·9	31	3·9	0·15	— 0·57	1	10·5	74
Perth, W. Australia	1018·1	+ 5·6	106	58	88·4	67·5	77·9	+ 4·1	67·3	56	3·9	0·19	— 0·15	5	10.3	74
Coolgardie	1009·6	— 1·9	112	57	95·7	66·6	81·1	+ 3·7	63·6	42	3·9	0·39	— 0·07	4	..	..
Brisbane	1012·4	+ 1·1	99	64	86·9	69·0	77·9	+ 0·7	70·8	59	5·4	3·06	— 3·44	3	10·3	76
Hobart, Tasmania	1006·9	— 3·4	93	45	72·1	53·2	62·7	+ 0·7	52·8	46	6·0	0·28	— 1·55	7	8·8	59
Wellington, N.Z.	1008·6	— 4·7	71	41	64·7	52·0	58·3	— 4·2	54·8	71	7·0	2·16	— 1·17	11	7·6	51
Suva, Fiji	1006·6	— 0·9	91	69	85·4	74·5	79·9	0·0	75·3	80	7·6	11·66	+ 0·23	24	5·2	40
Apia, Samoa	1007·2	— 0·7	89	73	84·6	75·1	79·9	+ 0·9	77·2	82	7·4	21·34	+ 4·29	19	5·1	40
Kingston, Jamaica	1014·7	— 0·4	90	64	86·2	67·9	77·1	+ 0·3	66·0	84	3·0	0·41	— 0·55	4	8·8	79
Grenada, W.I.	1013·3	+ 0·5	90	70	87·0	72·9	79·9	+ 2·8	74·5	78	6·3	10·39	+ 6·01	27	..	..
Toronto	1018·2	+ 0·3	56	13	39·9	30·6	35·3	+13·1	32·3	82	8·2	5·32	+ 2·53	12	1·5	16
Winnipeg	1017·6	— 3·3	35	—29	14·4	—1·9	6·3	+10·2	..	..	4·6	0·00	— 0·91	0	..	..
St. John, N.B.	1018·4	+ 2·9	55	0	35·4	19·9	27·7	+ 8·5	23·5	78	7·0	4·54	— 0·26	9	3·3	36
Victoria, B.C.	1018·4	+ 2.4	50	16	41·3	34·7	38·0	— 1·0	35·4	87	7·7	4·23	— 0·31	19	2.5	28

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

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The Influence of the Ice in Davis Strait on the Weather of the British Isles

The publication by the Danish Meteorological Institute* of a study of the variations of ice conditions in Davis Strait affords an opportunity of investigating the bearing of this distant region on the subsequent distribution of pressure in the neighbourhood of the British Isles. The severity of the ice conditions was estimated from six different criteria on a scale of 0-10, the average figure for the whole series of years being 4·94.

In order to obtain conformity with a general investigation into the effect of ice conditions, only the 33 years 1895 to 1927 were utilised. The ice figures were correlated with overlapping three-monthly means of pressure at nine stations, beginning with July to September of the ice year, and continuing to the end of the second year. Some of the results are shown in fig. 2. In studying this figure it must be remembered that the pressure data employed are overlapping means of three months. If any isolated month has by accident a high correlation with the ice data, this will appear as a hump on the curve covering three months only, and such a hump may have no real significance. On the other hand, there is practically no correlation between the pressures in successive three-monthly periods,† so that a

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*Meddelelser No. 8. The state of the ice in Davis Strait, 1820-1930. By C. I. H. Speerschneider. København, 1931.

†See *Meteorological Magazine*, 63, 1928, p. 44.

(99489) 107/27 1,050 8/32 M. & S. Gp.303

hump or trough extending over four or more months probably indicates a real relationship.

The first point to notice is that towards the end of the year to which the ice measurements refer, there is negative correlation between ice and pressure at Stykkisholm in Iceland, and positive correlation between ice and pressure at Bergen, Paris, Berlin, and to a less extent, Gibraltar. In other words, with much ice in Davis Strait, the Icelandic low tends to increase in intensity, while pressure tends to be above normal over the whole of western Europe.

The curve for Stykkisholm in fig. 2 is persistently low over a period of six months, so that by the criterion given above, the deepening of the Icelandic low in years of much ice is probably real, but the west European hump extends over only three months and may be accidental. The physical relationship involved is fairly clear; much ice to the west of Greenland displaces the low pressure to the eastward and concentrates it over Iceland. In the second half of the following year there is a prolonged hump over western and central Europe, extending from Bergen in the north to Gibraltar in the south, and from Valentia in the west at least as far as Berlin in the east; at Paris in the centre of this region the correlation coefficient rises to + 0·57 in August to October. This feature is probably real, but the isolated dip at Ponta Delgada may be accidental. The average change of pressure corresponding with an increase of Davis Strait ice from a scale value of 1 to 10 is shown in fig. 1.

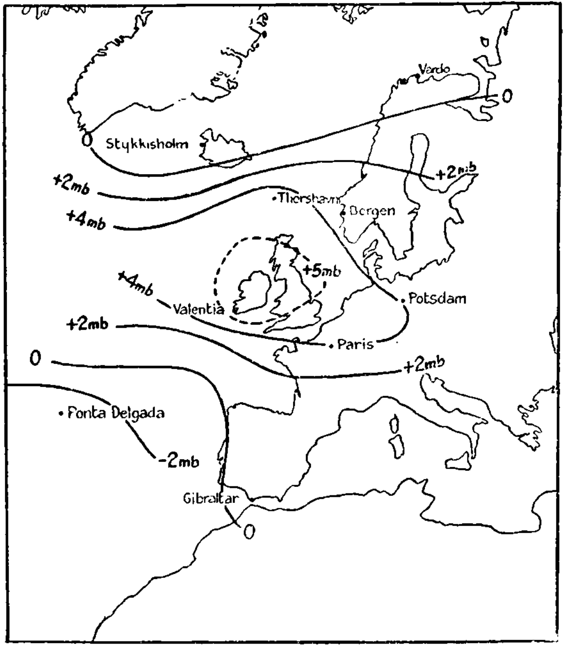


FIG. 1.

It is not easy to see in what way an excess of ice in Davis Strait can bring about an excess of pressure in western Europe late in the following year, but possibly the sequence may be somewhat as follows :—In a year of much Davis Strait ice, owing to the deepening of the Icelandic low there is a tendency for

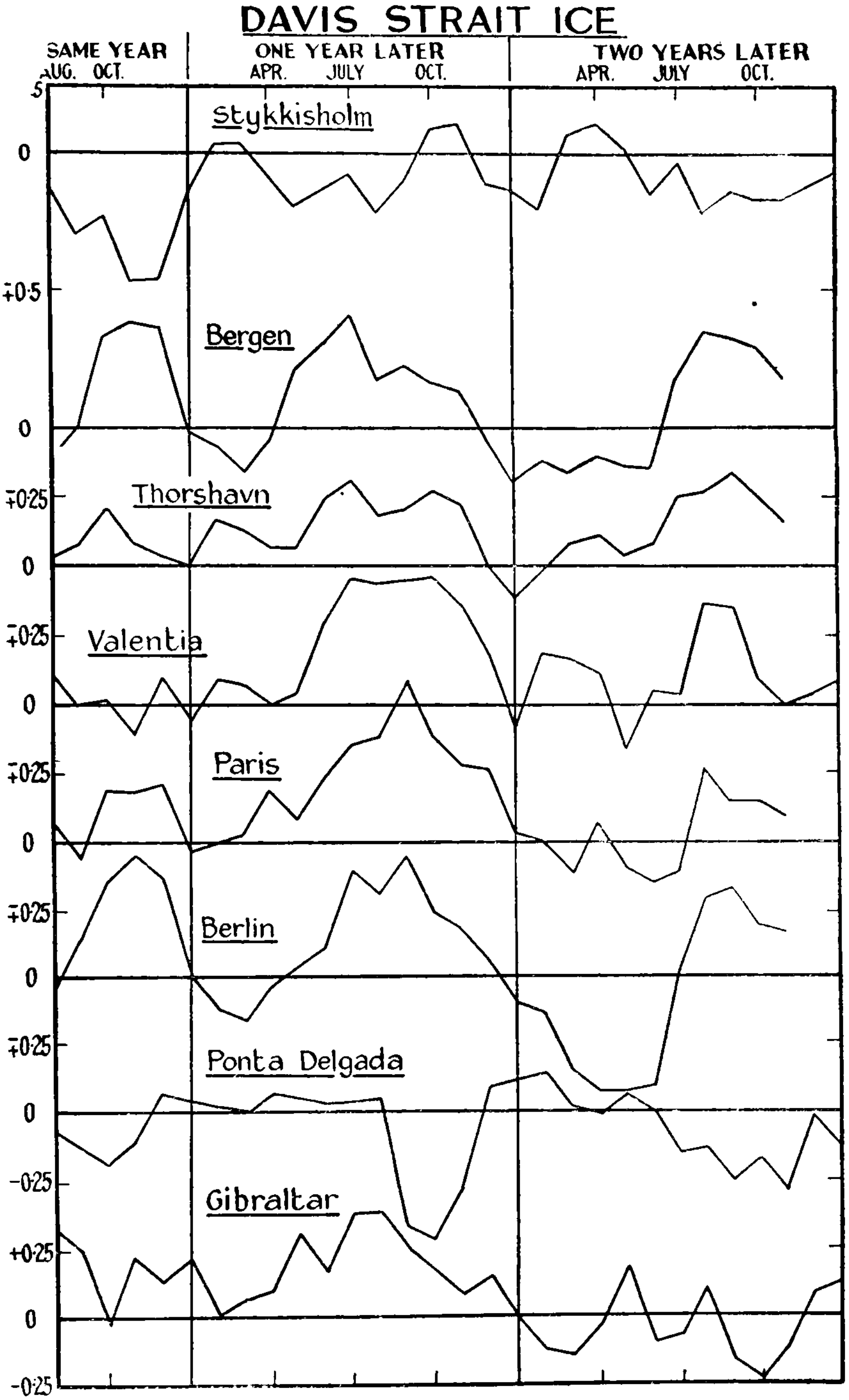

DAVIS STRAIT ICE
SAME YEAR
AUG. OCT.
ONE YEAR LATER
APR. JULY OCT.
TWO YEARS LATER
APR. JULY OCT.
Stykkisholm
Bergen
Thorshavn
Valentia
Paris
Berlin
Ponta Delgada
Gibraltar
.5
0
∓0·5
0
∓0·25
0
∓0·25
0
∓0·25
0
∓0·25
0
∓0·25
0
−0·25
+0·25
0
−0·25

FIG. 2

strong south-westerly winds in autumn between Iceland and Norway. These drive much relatively warm water into the basin of the Arctic Ocean, so that the body of the ocean beneath the ice becomes warmer than usual. In winter and spring this warm water, shut off from the air by the ice cover, is unable to exercise any appreciable effect, but it facilitates the break-up of the ice in the following summer (the correlation between Davis Strait ice and Arctic ice in the following year is −0·41). A warm Arctic ocean tends to give stormy conditions and low pressure in high latitudes, while the evacuated air is deposited further south and causes a belt of high pressure over Europe. In support of this tentative explanation it may be remarked that the correlation between pressure at Vardo, in the extreme north of Europe, and Davis Strait ice in the preceding year, is persistently negative, though not large.

After the period shown in fig. 1, the correlation coefficients are mostly small and irregular, and it is not probable that the direct influence of Davis Strait ice can be traced further. I wish to acknowledge the assistance of Mr. F. Metcalfe in calculating the coefficients referred to above.

C. E. P. Brooks.

Summer Weather in Ungava Bay

A summary of the meteorological work of the Oxford Hudson Strait (1931) *Expedition and a commentary on the report of Mr. A. J. G Langley.*

By S. T. A. Mirrlees, M.A.

During the summer of 1931 the "Oxford Hudson Strait Expedition" spent parts of August and September on Akpatok Island, lat. 60°20′N., long. 67°56′W., a little-frequented island in the north-western part of Ungava bay, the southward extension of the eastern part of Hudson strait. The hydrographical and meteorological work of the expedition, which was in the charge of Mr. A. J. G. Langley, included a fairly extensive programme of meteorological observations, eye observations being made at three fixed hours daily and autographic records maintained of pressure, temperature and humidity. The various records were kindly lent by the Oxford University Exploration Club to the Meteorological Office, and in view of the scarcity of meteorological data from the Hudson strait region it has been thought of interest to give a short summary here.

The base camp of the expedition was situated at the mouth of a valley, trending westward, on the east coast of the island, and the barograph was in use at this position, some 20 feet above the sea level, while the Stevenson screen containing the other instruments was situated 100 yards to the north and 75 feet above sea level. The autographic records of pressure, temperature and humidity for the period August 21st, 1931, to September 17th, 1931, have been tabulated, and the results of these tabulations may be summarised.

The average barometric pressure for the period was 1,011mb. As no opportunity had occurred of standardising the barograph against a mercurial barometer, an attempt was made to check the accuracy of the readings by comparison with values interpolated from the isobaric charts of the *Daily Weather Report.* While this procedure is satisfactory where the network of observing stations is fairly close, as in the British Isles, it must be regarded as somewhat rough and ready in the present instance and the result, that the barograph on an average of 21 readings was 3mb. high (probable error, ±0.3mb.), can be taken as an indication that the instrument was in reasonably good adjustment.

The diurnal variation of pressure, with an amplitude of 0.5mb., is well marked considering the short period of observations. Pressure varied between 1,024mb. and 989mb., the average daily range (midnight to midnight) being 7mb. and the greatest daily range 23mb.

The thermograph readings were standardised by means of the three daily eye observations of temperature. The corrections to the thermogram readings are somewhat irregular owing, presumably, to slight errors in clock timing in conjunction with numerous small oscillations of temperature which form a conspicuous feature of the thermograms in the late evening and early morning. These oscillations at times give the curves the appearance associated with the passage of " fronts "; it may be presumed that they are ultimately an effect of the topography, but in the absence of autographic records of wind no attempt at a detailed explanation is made.

The mean temperature for the whole period was 44.5°F., and the amplitude of the diurnal variation about 4°. The highest hourly reading was 65° and the lowest 36°, whereas according to the maximum and minimum thermometers the extremes were 65° and 32°—the discrepancy in the minimum readings is due to the fact that the thermograph was out of action on the day of the occurrence of the actual lowest temperaure.

The mean relative humidity over the period was 83 per cent. with a small diurnal variation. The hygrograms show small oscillations, the inverse of those on the thermograms.

The prevailing winds were westerly, and on a few occasions easterly winds were experienced, but there were scarcely any winds from northerly or southerly directions. The direction of wind was evidently strongly controlled by the topography. Gale force was recorded at 6 per cent. of the observations. It is difficult to say how closely these observations represent normal conditions in August and September at Akpatok.* There are no stations for which normal values are available nearer than Hebron (Labrador) and Port Churchill (on the western short of Hudson Bay). Of these Port Churchill has the more extreme climate, the summer there being 5° to 10° warmer and the winter about 15° colder than at Hebron, while the spring and autumn temperatures are about the same. The mean temperature recorded at Akpatok island agrees to within 1° with the interpolated value for the normal during the corresponding period at Hebron, and is about 2° lower than that for Port Churchill.

Some daily values for Port Burwell, about 70 miles to east-north-east of Akpatok island appear in the *Daily Weather Report*, and an attempt was made to compare these with the corresponding observations at the island.

The temperature at 20h. 75th meridian time was, on the average of nine observations in August, 11° warmer at Akpatok island than at Port Burwell, and on the average of nine observations in September, 4° warmer at Akpatok island. On two occasions only was the temperature at Port Burwell the higher. There is not sufficient information to explain these differences.

Of 21 occasions on which comparable observations are available, there were 10 on which the directions of wind at the two places were in agreement, six on which it may be surmised that a katabatic wind was blowing at the base in opposition to a weak gradient of pressure, three on which minor "frontal" phenomena were probably present, and two occasions on which discrepancies in wind direction appeared, for which no explanation can be proposed. None of the frontal phenomena present was well marked; on the occasion of the greatest barometric movement a depression was passing to the southward. The average temperature of the sea water was 37°, or 7.5° below the air temperature. A single observation of temperature of the soil was made, by digging into the ground and inserting a thermometer into the sides of the excavation.

At the time of observation the air temperature 3 ft. above the upper surface of the vegetation was 3° lower than that 2 in. above the surface. Half an inch below the upper surface of the vegetation the temperature was 1° higher than at 2 in. above it. The thickness of the covering of vegetation was 4 in. In the ground the temperature fell from 45° at 3 in. below the surface to 40° at 2 ft. 6 in. below the surface, at which depth solid rock was reached.

The following is a summary of the results in tabular form:—

---

*In the report a note is made of the fact that the weather conditions in the Ungava Bay region may be extremely localised.

AKPATOK ISLAND

Lat. 60°20′N., long. 67°56′W.

Period, August 19th, 1931, to September 18th, 1931

Pressure

Mean	1,011mb.	Mean absolute daily range	7mb.
Highest	1,024 ,,	Highest ,, ,, ,,	23 ,,
Lowest	989 ,,	Lowest ,, ,, ,,	2 ,,
		Amplitude of mean diurnal variation	0.5 ,,

Temperature

Mean	44.5°	Mean absolute daily range	9.2°
Highest	65°	Highest ,, ,, ,,	22.5°
Lowest	32°	Lowest ,, ,, ,,	3.7°
Mean temperature of sea water	37.2°	Amplitude of mean diurnal variation	3.9°

Relative humidity

Mean	83 per cent.	Mean absolute daily range	23 per cent.
Highest	100 ,, ,,	Highest ,, ,, ,,	36 ,, ,,
Lowest	53 ,, ,,	Lowest ,, ,, ,,	2 ,, ,,
		Amplitude of mean diurnal variation	10 ,, ,,

Wind

No. of occasions of

	Force 8 or above	Force 4 to 7	Force 1 to 3	Calm	N	NE	E	SE	S	SW	W	NW
*8h.	3	10	8	8	0	2	1	1	0	2	14	1
14h.	2	11	14	2	0	4	6	1	0	1	13	2
20h.	0	14	9	6	0	2	4	0	1	1	13	2

Correspondence

To the Editor, *The Meteorological Magazine.*

Well-defined Rain Area

I witnessed a rather remarkable phenomenon during the thunderstorm this afternoon (August 1st).

I was standing under the porch of the Metropolitan Railway Station in Queen's Road, Bayswater, at 2.30 p.m. The sky was suddenly overcast with dark clouds. The prevailing wind was from SW. Towards the north-east I saw small stringy clouds approaching (from the north-east) and seeming to rise in the sky—this is perhaps a normal prelude to a thunderstorm.

It began to rain—heavily at first and then softly. Suddenly torrential rain fell only one hundred yards from where I was standing. The nearest trees in Kensington Gardens were almost hidden behind a milky mist of heavy rain. The rain-drops rebounding off the street created a layer of spray as high as the tops of the wheels of the taxis standing in the street. Where I was sheltering, hardly a drop of rain was falling. The contrast was so striking that I called the attention of an unknown bystander (as though I could not believe my eyes). Then the spray on the ground came nearer like a wave, and receded. Suddenly it vanished completely, and the trees behind in Kensington Gardens stood out black against the sky. It was over. Afterwards the storm continued in a normal manner.

---

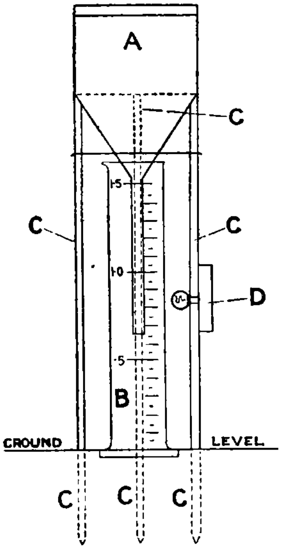
*Standard of time. Newfoundland Summer Time, 2h. 31m. slow on G.M.T.

I have witnessed phenomena something like this in the Tropics; but never before have I seen in England really torrential rain a hundred yards away, with only a few drops falling where I was standing. It was extremely local, and, I suppose, was something in the nature of a waterspout.

G. A. Hinkson.

23, Queensborough Terrace, London, W.2. August 1st, 1932.

Intense Rain in Hertfordshire



A. FUNNEL.
B. GRADUATED GLASS RECEIVER.
C.C.C. WOODEN SUPPORTS..
D. LAMP & BATTERY.

Rain of noteworthy intensity accompanied the eastward passage of a short but severe thunderstorm over the district of Hertfordshire between Rickmansworth and Chorley Wood early in the afternoon of July 27th. For the 5½ minutes from 13h. 25m. to 13h. 30½m. (G.M.T.) the measurement here was 0.42in. At 13h. 27m. the downpour became extremely heavy for about one minute. Eye observations made from shelter with a gauge of special construction and a stop watch showed that 0.10in. fell in 49 seconds. Of this, the first 0.05in. occupied 24 seconds and the second 0.05in. 25 seconds. The rates of fall per hour were thus 7.35in. for the whole interval of 49 seconds, 7.50in. and 7.20in. for the first 24 seconds and last 25 seconds, respectively.

During the storm the wind veered from WSW. to W., with a squall of force 6, while temperature in the screen dropped suddenly from 62.0°F. to 56.4°F. There was no hail. When rain finally ceased at 13h. 32m. the road along the valley was flooded several inches deep at its lowest point. Bright sunshine followed at 13h. 35m., and set the whole countryside " steaming " for a few minutes.

The simple contrivance from which the above short-period measurements were obtained was suggested by a diagram of an early model of Symons's " Storm " rain-gauge, devised by the founder of the British Rainfall Organization for use at Camden Square some 60 years ago. A standard 8-in. funnel is mounted on a skeleton wooden frame over a glass receptacle so clearly graduated that the level of the contained water can be read from shelter at any moment with the aid of a binocular. The attachment of a small electric bulb and battery to the framework of the instrument enables observations to be made at night. There is usually very close agreement between the readings thus obtained and those from the ordinary 5-in. gauge situated 30 yards distant. In the storm of July 27th the two totals were identical.

E. L. HAWKE.

Caenwood, Rickmansworth, Herts. July 29th, 1932.

Heavy Rain in Manchester

Mr. W. F. H. Creber, Engineer to the Manchester Corporation Waterworks, forwards some details of the thunderstorm which occurred during the evening of July 11th to the east of Manchester. At Arnfield Reservoir and Godley Reservoir the amounts for the rainfall day were 3.05in. and 3.64in. respectively. At Stalybridge (Swineshaw Lodge) and Stalybridge (Brushes Reservoir), where records are maintained by Mr. M. T. B. Whitson, the amounts were 3.65in. and 4.02in. respectively. The bulk of the rainfall occurred within 4 hours from 16h. to 20h. Mr. Creber compares the storm with that of June 18th, 1930, when 3.59in. was measured at Rhodes Wood Reservoir and 4.10in. at Glossop Waterworks (Swineshaw) nearer the Peak. So far as the catchment area of the Manchester Corporation in the Longdendale Valley is concerned Mr. Creber concludes that " in amount and intensity the fall on July 11th, 1932, is a record, taking into account the area over which 3in. or more fell.'' The damage to watercourses, &c., was certainly greater then than on June 18th, 1930.

Water Spouts at the Lizard

Mr. J. E. Clark, of Street, Somerset, has sent the following extract from *The Friend* of July 22nd, 1932 :—

Water Spouts at the Lizard. . . . At ten o'clock last Wednesday morning (July 13), an interesting squall cloud appeared off here. During its passage the wind changed from north-east to south, and a heavy shower fell. From the edge of this cloud out at sea, a whole series of " funnel clouds " formed. Even though the actual clouds never quite reached the sea, the vortex evidently did, as the sea below each funnel was very much disturbed and appeared as if boiling, and a cloud of "steam" above it was circling rapidly.

The hollow core of the funnel cloud was clearly visible as a white band down the centre of the funnel, and the whole cloud was in a state of rapid turbulent motion.

These clouds kept forming and disappearing for about a quarter of an hour, and at one time as many as seven were visible at the same time. The rapidity with which the spouts formed and vanished again was at times extraordinary: it was just as if some mysterious tongue was being flicked out of the cloud and back . . . . . A. C. PHILLIPS, Tresawle, The Lizard, Cornwall.

Tornadoes at South Farnborough, Hants

During the latter part of the morning of May 30th, 1932, a wide belt of black, ominous looking cloud had been steadily forming and at 12h. 35m. B.S.T. stretched almost from the south-south-west to the north-north-east horizon, the centre of the belt being somewhat to the east of the zenith. At this time our attention was called to a funnel-shaped protuberance hanging vertically downwards from a much disturbed under-surface part of the black cloud at a distance of about two miles to the south-south-east, and we soon realised we were watching a small tornado, grey in colour against the dark background. The height of the black cloud base was 3,000 to 4,000 feet and the lower end of the tornado appeared to be eclipsed by lighter scud at about 2,000 feet above the ground. Approximate calculations showed that the length of the funnel was of the order of 250 feet and the width of the thickest part about thirty feet. After a minute or so the end swung first to the left and then to the right and finally became vertical. The sides, which had previously been clear cut, now became diffuse, and wispy cloud appeared to be ascending there in spirals about vertical axes. Soon after this, at about 12h. 40m. the tornado appeared gradually to withdraw into the cloud base after being under observation for about five minutes. Meanwhile another had formed about 2,000 feet to the left of the first but did not attain to the same length; it was wider and truncated. Between 12h. 40m. and 12h. 50m. two further truncated tornadoes formed suddenly near the second position, but both gradually withdrew into the cloud. All four tornadoes appeared to be stationary and to form along a line about midway between the further edge and the south-south-west to north-north-east axis of the black cloud belt, but there is some divergence of opinion as to whether the line of formation was parallel to this axis or inclined at an angle to it. The phenomenon ceased at 12h. 50m. At 12h. 55m. large drops of rain began to fall followed at

13h. 5m. by heavy rain in the nature of a cloudburst, 5mm. being recorded in nine minutes and 10mm. in twenty-one minutes. The rain moderated at 13h. 45m. but did not cease until 14h. 35m., giving a total fall of 14.1mm. The ensuing clearance indicated that the rain belt either remained practically stationary and dissipated its energy or moved very slowly northward. The heavy rain caused a small amount of flooding.

The synoptic charts for May 30th showed a series of very shallow low pressure areas over southern England between depressions to the west and east and anticyclones to the north and south. Although the belt of black cloud gave the impression of a stationary line squall cloud there was no obvious front indicated on the surface over southern England. The evidence available points either to a convergence of wind currents or to the formation of an unstable condition of a warm easterly underneath a colder westerly current. Midday balloon ascents from stations to the east gave light southerly surface winds backing to SE. or E. above 2,000 feet, while those to the west and south-west showed light WSW. or W. winds at all heights up to 4,000 feet. At the time of the tornadoes the wind at the surface was calm apart from gusts of 5 m.p.h. at 12h. 38m. and 12h. 45m., and near objects were unusually clear. Nephoscope observations on the cloud level at the top of the tornado (about 4,000 feet) gave a wind of 12 m.p.h. from WSW.; on the scud at about 2,000 feet, 5 m.p.h. from E. Subsequently the winds became light, westerly at all heights up to 4,000 feet with a layer of very light north-easterlies from 5,000 to 8,000 feet. There were no pressure changes indicated whilst these tornadoes were in evidence, but a slow rise of 0.5mb. occurred between 13h. and 14h. Temperature fell gradually 2°F. from 12h. 30m. to 12h. 45m., was steady to 13h. 5m. followed by a 2.5°F. fall at 13h. 5m. The corresponding humidity trace showed a rise of 7 per cent. at 12h. 35m., a gradual rise of 1 per cent. to 13h. followed by a sharp rise of 13 per cent. to 13h. 35m. The only available upper air temperature record at this station was a single reading at 2,000 feet at 10h. 30m., *i.e.*, before the belt of cloud began to form. This showed a lapse rate of 4°F. per 1,000 feet between the ground and 2,000 feet. The midday ascent at Duxford gave a similar lapse rate up to 2,000 feet and above 3,000 feet, but in the layer between these figures a much steeper rate of 7°F. per 1,000 feet. The temperature at 2,000 feet had risen 8°F. since the morning ascent, but that at 3,000 feet—the cloud base—only 2°F.

W. H. Bigg.
J. S. Smith.

Royal Aircraft Establishment, S. Farnborough, Hants. June 15th, 1932.

Brighter Meteorology

It is difficult to think of Meteorology as a subject for levity and the *Meteorological Magazine* cannot be accused of ever departing from its dull, but instructive tenor. The following weather diary written by an Asiatic subordinate officer, temporarily loaned to the Meteorological Service, may be of interest.

" May 14th, 1932. The day unveiled a bright sky with the sun in the lifeless East amidst the white clouds like speckled beads in a bride's veil and existed till afternoon."

When asked where he got this from he replied that when in doubt about the weather he always read up Edgar Wallace's descriptions.

V. A. LOWINGER.

Malayan Meteorological Service, Kuala Lumpur, Malaya. July 1st, 1932.

NOTES AND QUERIES

Atmospheric Effects resulting from the Andine Eruptions

In an article in the *Meteorological Magazine* for May, it was pointed out that the spread of volcanic dust from the Andes might be expected to cause optical phenomena in the southern hemisphere, but not in the northern. This expectation has been justified, for sunset glows have appeared in both South Africa and Australia. The eruptions began on April 10th; letters from Johannesburg published in *Nature* for June 25th and July 23rd describe sunset glows which began before May 3rd and were still continuing, even becoming finer, on May 18th. The letters describe a strong red glow extending over nearly the whole sky on most nights, even when no clouds are present. The red light was so powerful that everything caught a reflected tint; it was best about an hour after sunset, when normally it is quite dark.

A letter from Mr. R. C. Barnes in *The Times* for June 30th also describes flaming pink sunset glows in the Orange Free State in April and May. A letter from Mr. M. P. Cogan, Perth, Western Australia, dated May 30th and published in *The Times* for June 28th describes beautiful after-sunset and before-sunrise glows during the preceding month over the whole of Western Australia and also in eastern Australia and New Zealand. Hitherto no reports of optical phenomena due to volcanic dust have been received from the northern hemisphere.

A letter from Dr. E. Kidson, referred to in *Nature* for July 23rd, describes the sunsets in New Zealand as commencing about the end of the first week in May, and ranging from pale pink to yellowish pink. Dr. Kidson also states that the measurements of solar radiation at noon, made with an Ångström pyrheliometer, showed a sudden decrease of about 10 per cent. on May 5th, followed by a slight recovery. The distance from the Andes eastward to New Zealand is about 13,000 miles, and it appears that the main mass of volcanic dust travelled eastwards at 20-30 miles per hour; an unexpectedly low velocity compared with that reached by the Krakatoa dust.

A striking phenomenon of the Krakatoa eruption was the series of atmospheric waves which travelled several times round the world, and which was recorded on barographs in all countries. The general nature of the waves was a slight rise and a sudden fall of about 1mb., followed by a period of disturbance lasting one to two hours. Since the Krakatoa eruption the sensitive micro-barograph has been invented, and the micro-barograph records from stations in the British Isles, Egypt and Iraq have been searched for traces of similar disturbances. A wave originating in the Andes on the morning of April 10th should have reached England on the afternoon of the same day, but although most of the records show a series of minor fluctuations, there is no one feature which is common to all of them, while the record from Lerwick is practically a straight line with no disturbance of any kind. Hence it can be said that we have no instrumental record of the passage of air waves from the Andine eruptions across the British Isles or the eastern Mediterranean.

This result is not unexpected. The Krakatoa air waves were due to a single explosion of extreme violence which almost demolished the island, but the South American phenomena included an intermittent series of far less intense explosions in a number of different volcanoes.

The Shyok Dam

The Times for July 13th contained the news that an ice dam on the upper part of the Shyok River, a tributary of the Indus, burst at 3 a.m. on July 12th, and that the Indus was rising rapidly. The peculiar configuration of this area was described in the *Meteorological Magazine* for September, 1929; briefly, four glaciers protrude from the westward into the upper Shyok, and from time to time extend completely across the narrow valley. Behind the barrier formed in this way a lake is formed, until the pressure of the water breaks through the dam and the accumulated mass pours down the valley. This happened in August, 1929, when the Indus, already high, reached a level of more than 50 feet above normal and caused serious damage by flooding.

On the present occasion the Shyok River rose rapidly 50 feet but subsided again as rapidly. The Indus was low, and although it rose to 30 feet above normal, the water was quickly carried away and no serious damage was done. The cause of the sudden fall is believed to be that after the Shyok had broken through the dam, the rush of water swept great blocks of ice into the gap and quickly closed it again.

The Malayan Meteorological Service

In 1928 the Malayan Meteorological Service, which is a branch of the Survey Department of the Federated Malay States and Straits Settlements, was greatly expanded, and Mr. C. D. Stewart was appointed Superintendent. In the following years a number of new stations were established, completely equipped with autographic instruments and staffed by full-time observers, while the previously existing stations were inspected and their observations placed on a uniform basis. The results of these activities appear in the "Summary of observations, 1931," recently published as a volume of 195 folio pages, mainly tables.

A descriptive introduction gives a good general account of the normal climate of Malaya and the departures from normal during 1931. Then follow tables for 18 meteorological branch stations, including three at levels above 4,000 feet. These summaries are remarkably complete, each station occupying eight pages. They include the monthly averages and extremes of maximum and minimum temperature, rainfall, sunshine and days with various phenomena, full observations at three fixed hours daily, frequency tables, hourly means for each month of temperature, humidity, sunshine and rainfall, and analyses of the pressure-tube anemograms. Finally there are shorter summaries of temperature, humidity and rainfall for 49 auxiliary stations, mostly observing three times daily. A large folding reference map shows the positions of all these stations. The volume is excellently produced, and the apparent freedom from errors reflects credit on both printer and proof-reader.

Alpine Climatology

Dr. V. Conrad, Professor of Meteorology at the University of Vienna, has recently published the results of several researches into the climate of the Alps. Of special interest is a study of the duration of the snow-cover,* in which the duration at different heights is approximately defined by the equation:

$$\text{Duration (days)} = 23 + 0{\cdot}1\,h,$$

where h is the height above sea-level in metres. Inner valleys parallel with the mountain ranges have shorter durations, and the weather side of the mountains longer durations than those given by the formula. The decisive factor is the total snowfall; other elements are of less importance.

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*Beitrag zur Kenntnis der Schneedeckenverhältnisse in den österreichischen Alpenländern, by C. Conrad and M. Winkler. *Gerlands Beitr. Geophys., Leipzig*, 34, 1931, pp. 473-511.

Conrad and Biel* describe the duration of temperatures within definite limits, a study of special botanical interest. The durations in days of temperatures above 5°C. (41°F.) are expressed by the formulæ:

Switzerland $D = 268 - 0{\cdot}0698\ h.$
Lower Austria $D = 240 - 0{\cdot}0556\ h.$

A third paper† deals with the climate of the Austrian mountain health resort of Semmering and the neighbouring district. The distribution of the various elements (rain and snowfall, cloudiness and sunshine) according to elevation is discussed statistically and detailed tables are given for a number of stations. A favourable feature is the abundant winter sunshine.

Reviews

British Rainfall, 1931. Size, 9 × 6. Pp. xxi + 306. 2 Plates. *Illus.* Price 15s. net.

The seventy-first annual volume of *British Rainfall* includes the records from 5,329 stations. The number of stations in England, Wales and Ireland is practically identical with that in the previous volume, while in Scotland there is a net gain of 16 stations. The county with the largest gain is Ayrshire, and this is due mainly to the enthusiasm of Mr. W. Dunbar, F.R.Met.Soc., who collects the rainfall data monthly and sends a summary, including a map showing the distribution of the rainfall, soon after the close of each month to all contributing observers.

The volume, which is on the same lines as its predecessors, is a comprehensive summary of the rainfall of 1931, both as regards its incidence during the year and its variations from place to place. There are, in addition, a number of special articles dealing with problems relating to the exposure of raingauges and discussing some of the long series of records which have been accumulated.

The section dealing with "Heavy falls on rainfall days in 1931" contains an account of the rainfall of November 2nd and 3rd, when 9.61 inches was recorded at Blaenau-hydfer between Trecastle and the Black Mountains, and of the cloudbursts near Bootle (Cumberland) on June 14th, 1931.

The general table, showing the annual rainfall at the 5,329 reporting stations, includes a column for the average annual amounts. This column is more complete each year, as additional averages are computed, and in the present volume averages are given for more than half the stations.

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*Isanomalen der Andauer einer bestimmt vorgegebenen Temperatur. *Stockholm, Geogr. Ann.*, 1929, pp. 209-312.

†Zum Klima des Semmeringgebietes. *Wien Beih. Jahrb. Zentralanst. Meteor. Geodyn.*, 1928.

The special articles include a discussion by Mr. E. G. Bilham of the measurements of evaporation at Valentia Observatory, Co. Kerry, which shows that the anomalous results obtained from the tank in wet, windy weather may be accounted for by losses due to outsplashing. A subsequent article gives estimates of the general monthly rainfall over England and Wales from 1727 to 1931.

It is satisfactory to find that the volume was published on August 16th, a date earlier than that of any other year since before the war.

An Elementary Geography of the Gold Coast. By D. T. Adams, B.A. (Oxon).

Although this book has been written primarily to provide the scholars of the Gold Coast with a geography of their own country, it will undoubtedly be of much value also to anyone requiring information about this fascinating colony of our Empire, for it is full of interesting facts about the country, its people and its trade.

Writing this review as I steam along the African coast, I cannot help recalling to mind the former reputation of this part of the Empire as being the " white man's grave." After reading Mr. Adams' account of the development of the country in recent years, even those hitherto unacquainted with the colony will realise that the various civilising factors, one of the principal of which has been education, have brought about vast changes in the Gold Coast and that this colony is now one of the most progressive in the Empire. An indication of the scale on which the country has been developing may be gathered from the amazing growth of the cacao farming industry alone. The value of cacao exports has increased from £755,347 in 1909 to £11,229,512 in 1928.

The book is fully illustrated and is written in an easy style which should appeal to students, the principles of geography being introduced through examples with which they are thoroughly familiar in their everyday life. At the end of each chapter is a summary of its contents and a set of questions and practical exercises, which should be of considerable value in bringing home to the students the close connexion betwen the subject and the life around them. The chapter on the weather is particularly interesting and forms a useful introduction to climatology for schools.

This is an admirable little book that can be highly recommended.

L. G. GARBETT.

Memorie del R. Ufficio Centrale di Meteorologia e Geofisica. Ser. 3, vol. 3. Rome, 1931.

The third volume of the fine series of memoirs published by the Italian Meteorological Service in recent years contains five papers. The first, and by far the longest (164 pages), by G. Agamennone and A. Cavasino, consists of a study in great detail of the earthquake of the western Riviera on February 23rd, 1887. A valuable paper by P. Gamba discusses the occurrence of fog at Pavia, the frequency of various types of fog being shown in a number of tables, while special examples receive detailed examination on the basis of meteorological observations at intervals of a minute or so. The vertical distribution of temperature and humidity up to 1,500 metres during fog is illustrated by a number of diagrams. The same author gives the results of a number of pilot-balloon ascents at the Royal Geophysical Observatory of Pavia in a detailed paper on the lower currents of the atmosphere, changes of velocity and direction being presented month by month up to 6,000 metres. D. Pacini discusses the results of a large number of observations of condensation nuclei and atmospheric dust, emphasis being laid on the importance of Aitken nuclei near the ground. The average number of the latter at Bari was found to be 33,400 per cubic centimetre. The transparency of the atmosphere depends principally on the number of these nuclei and the relative humidity, nuclei of marine origin being especially apt to cause obscurity. It was found that water vapour does not condense on dry dust. The final memoir by A. Puppo gives a statistical summary of rainfall at Conegliano near Venice.

India Meteorological Department, Scientific Notes. Vol. III, No. 22. *The Structure and movement of a storm in the Bay of Bengal during the period 13th to 19th November,* 1928. By K. R. Ramanathan, M.A., D.Sc.; and Vol. III, No. 24: *On the utility of observations of barometric characteristics and tendencies for local forecasting in north-west India.* By R. P. Batty, B.A.

A depression with a warm sector moved north-westward into the Bay of Bengal. The first paper describes the life history of the system and the movements of the fronts, and the associated upper wind observations over India, which show the discontinuity.

In the second paper, the barometric tendencies at Quetta for the interval 4 a.m. to 7 a.m. (local time) are studied for the period July, 1928, to June, 1930. Owing to the large diurnal variation, the pressure is almost always higher at 7 a.m. than at 4 a.m., but the investigation shows that nevertheless the tendencies are of some value for forecasting. In particular, if the barometer is rising unsteadily the weather is likely to be unsettled during the day. (See also *Meteorological Magazine* 66, 1931, p. 231.)

C. K. M. DOUGLAS.

India Meteorological Department, Scientific Notes, Vol. I, No. 10.—*Distribution of temperature in the lower stratosphere.* By P. R. Krishna Rao, B.Sc.

The term " isothermal region " was used by the earlier investigators for what is now called the stratosphere, but had to be discarded when the progress of observations showed that in many cases the lower stratosphere was a region of increasing temperature. Some years ago it was shown* that over the British Isles the average distribution of temperature in the stratosphere begins with an inversion of 3°C. at the bottom; the present study analyses on similar lines data from 9 stations in other parts of the world between lat. 6°S. and 68°N., but mostly between 40° and 50°N. It is shown that the inversion layer at the base of the stratosphere is much deeper in tropical than in temperate regions; also lower values of the temperature at the base of the stratosphere are associated with deeper and more pronounced inversions. A qualitative explanation on lines given by Dr. C. Braak is added, the various phenomena being attributed to the more intense convection in tropical regions.

S. T. A. MIRRLEES.

Books Received

Hourly Sunshine at Wellington, January to June, 1929. By D. C. Meldrum, New Zealand, J.Sci.Tech., Vol. xi, No. 6, pp. 382-4, Wellington, 1930; and *Hourly Sunshine at Wellington, July to December*, 1929. By D. C. Meldrum, New Zealand, J.Sci.Tech., Vol. xii, No. 3, pp. 142-4, Wellington, 1930.

Nautisk-Meteorologisk Aarbog, 1931. The Danish Meteorological Institute, Copenhagen, 1932.

Obituary

We regret to learn of the death on August 6th, 1932, of Dr. J. E. Crombie of Parkhill House, Dyce, Aberdeenshire.

News in Brief

We learn from *Nature* that Dr. H. R. Mill has been appointed by the King of Norway a Commander (2nd class) of the Order of St. Olav for his services to Norwegian arctic explorers.

The Rev. J. P. Rowland, S.J., has been appointed director of the Stonyhurst College Observatory in succession to the Rev. E. D. O'Connor, S.J., who has been appointed rector of the College.

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*An analysis of the changes of temperature with height in the stratosphere over the British Isles, by L. H. G. Dines. *London, Mem. R. Meteor. Soc.*, Vol. 2, 1928, No. 18.

On July 23rd Mr. E. J. Hood retired from the Meteorological Office after a period of service only three months short of fifty years. Mr. Hood was born on July 24th, 1867, and entered the Office in 1882. For the first 38 years his work lay in the "Accounts" section, but in 1920 he was engaged on statistical work. For the last few years he has assisted in the compilation of *British Rainfall,* where his experience and accuracy proved very valuable. On his last day of duty Mr. Hood was the recipient of a presentation from the staff, in the form of a portable wireless set.

Erratum

JULY, 1932, title under the diagram facing p. 134; *delete* the word "Torquay."

The Weather of July, 1932

Pressure was above normal over Mexico, central North Atlantic, Greenland, Jan Mayen, Spitsbergen, northern Scandinavia, northern Russia and the central Iberian Peninsula, the greatest excess being 3.4mb. at 50°N.30°W. Elsewhere in North America and Europe pressure was below normal, the greatest deficits being 6.4mb. at 50°N.70°W., 4.6mb. at Corunna and 4.4mb. at Astrakhan. Temperature was above normal over the British Isles, Sweden (as much as 3½°F. in Svealand and Gothaland) and Spitsbergen and below normal in northern Norway, Switzerland and Portugal. Rainfall was generally in excess but deficient in Spitsbergen and parts of Sweden; in the north-east of Svealand it was only half the normal.

The weather over the British Isles during July was mainly unsettled. Thunderstorms were frequent in many parts, and consequently the total rainfall for the month was distinctly variable, only a few small areas having less than the normal amount of rain, while Cranwell (Lincolnshire) had more than four times the average fall. The mean temperature for the month was above normal generally, but sunshine was markedly deficient. During the first part of the month pressure was low near Iceland, giving unsettled weather in the north and west but mainly fine sunny conditions in the south and east. Except for a few local heavy falls the rainfall was slight during this period and the sunshine records good. Totals of from 13-15hrs. bright sunshine were sometimes recorded along the south coast between the 1st and 8th, Brighton had 14.8hrs. on the 8th. Thunderstorms occurred locally on the 3rd, 4th and 5th. Temperature was also mainly above normal, but the finest and warmest weather of the month occurred between the 9th and 11th, when a belt of high pressure extended from the Azores to the Baltic; 88°F. was recorded at Greenwich and 85°F. at

Nottingham, Huddersfield and Cranwell on the 10th. Night temperatures were also high during this time, being frequently above 60°F.; 67°F. was the screen minimum at Cambridge and Tottenham on the 10th. Widespread thunderstorms developed on the 11th, the thundery conditions persisting for the next few days; at Cranwell 5.11in. of rain were measured during a storm on the 11th, and a further fall of 2.40in. on the 13th, at Saltersford (Lincoln) 2.69in. on the 11th and 3.29in. on the 13th and at Llandysilio (Montgomery) 3.39in. on the 11th, and 2.93in. on the 12th. There ensued a period of cooler weather with shallow depressions covering most of the country; rain fell at times, but sunny periods were enjoyed in the north and west; Tiree had as much as 15.4hrs. sunshine on the 12th and 15.1hrs. on the 14th; Rothesay 15.2hrs. on the 17th. From the 18th to 23rd north-westerly winds prevailed and conditions were cool and changeable with much local thunder over the whole of Great Britain. Night temperatures were low on the 23rd and ground frost was experienced in parts of Scotland on that night, the ground minimum temperature at Dalwhinnie being 27°F. From the 23rd to the end of the month pressure was low over the British Isles and the weather unsettled, showery with bright intervals. Thunderstorms occurred at many places between the 24th and 27th, and the rainfall was heavy on the 24th and 25th, 3.42in. occurred at Devizes (Wiltshire) on the 24th, 2.19in. at Elham (Kent) on the 25th, and 2.16in. at Marlborough on the 24th. Much sun was recorded in the Midlands on the 25th with 14.8hrs. at Harrogate, and in southern Scotland and western England on the 26th with 12hrs. at Dunbar and 11.7hrs. at Falmouth. On the 29th the winds backed to SW. and temperature rose to over 70°F. both then and on the 30th. The 31st was a day of sunny periods interspersed with very heavy showers. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	147	+ 2	Liverpool	130	—63
Aberdeen	125	—34	Ross-on-Wye	135	—64
Dublin	137	—33	Falmouth	157	—68
Birr Castle	113	—31	Gorleston	148	—83
Valentia	71	—88	Kew	140	—61

The special message from Brazil states that the rainfall distribution was irregular generaly, with 0.47in. above normal in the northern, central and southern regions respectively. The crops were mainly in good condition. Four anticyclones passed across the country in the first two decades of the month. At Rio de Janeiro pressure was 0.2mb. above normal and temperature 2.5°F. above normal.

Miscellaneous notes on weather abroad culled from various sources. Widespread thunderstorms occurred over central Europe and Spain during the early part of the month, and much damage was done to the market gardens at Calahorra, Logroño, Spain, where two men were killed. A destructive hailstorm, lasting 20 minutes, followed by heavy rain was experienced in the district of Füssen, Upper Bavaria, on the night of the 6th; the hailstones were said to be nearly 2½in. in diameter. Heavy storms also swept across the Allgäu the same day. Serious floods were reported from various parts of Bavaria and some landslips occurred about the 12th. Much damage was caused by storms in Switzerland about the 12th, and as a result of a cloudburst on the 17th between Florence and Leghorn long stretches of railway line were washed away while heavy rain also caused damage near Brescia. Heavy rain occurred around the central tableland of Spain about the middle of the month and bitter winds and rain over Castile. (*The Times*, July 5th-20th.)

Torrential rains at the close of the rainy season have caused widespread flooding in western and southern Japan, with some loss of life and much destruction of embankments and bridges. The rain ceased on the 2nd and the floods were subsiding by the 3rd. The monsoon was active over India generally, and owing to unusually heavy monsoon rain, which made large breaches in the railways, communication between Rangoon and Upper Burma was interrupted. Canton was flooded on the 30th after very heavy rains; the deaths are estimated at 200. (*The Times*, July 4th-August 1st.)

During the middle of the month there were constant dry and fairly dense mists followed by violent sandstorms in southern Algeria. (*The Times*, July 18th.)

Weather conditions in Canada were generally favourable for the crops, though lack of rain caused a setback in some areas towards the end of the month. A tornado demolished the principal buildings of Washington (Kansas) on the 4th. Temperature was about normal early in the month in the United States, but rose generally above normal after the middle of the month, while the rainfall was mainly in excess at first but deficient later. A heat wave passed across the country about the 20th and 21st, when temperatures of 100°F. and over were recorded locally; 38 deaths were reported. Mild wet weather caused some damage to the crops in the Argentine. (*The Times*, July 14th-30th, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Rainfall, July, 1932—General Distribution

England and Wales	144	per cent of the average 1881-1915.
Scotland	121	
Ireland	138	
British Isles	137	

Rainfall: July, 1932: England and Wales.

Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square	1·93	81
Sur .	Reigate, Alvington ...	2·43	108
Kent .	Tenterden, Ashenden...	3·31	158
,, .	Folkestone, Boro. San .	4·24	...
,, .	Margate, Cliftonville...	2·50	126
,, .	Sevenoaks, Speldhurst	2·55	...
Sus .	Patching Farm	3·42	142
,, .	Brighton, Old Steyne..	2·70	124
,, .	Heathfield, Barklye ...	4·63	185
Hants .	Ventnor, Roy. Nat. Hos.	3·01	149
,, .	Fordingbridge, Oaklnds	3·59	179
,, .	Ovington Rectory	3·74	145
,, .	Sherborne St. John ...	2·54	114
Berks .	Wellington College ...	2·40	116
,, .	Newbury, Greenham...	1·87	84
Herts .	Welwyn Garden City...	2·19	...
Bucks .	H. Wycombe, Flackwell	1·45	...
Oxf .	Oxford, Mag. College...	2·86	126
Nor .	Pitsford, Sedgebrook...	4·34	184
,, .	Oundle....................	3·63	...
Beds .	Woburn, Crawley Mill	3·80	170
Cam .	Cambridge, Bot. Gdns.	2·43	112
Essex .	Chelmsford, County Lab	2·16	101
,, .	Lexden Hill House ...	2·21	...
Suff .	Haughley House.........	1·92	...
,, .	Campsea Ashe...........	2·95	128
Norf .	Norwich, Eaton.........	...	...
,, .	Wells, Holkham Hall	2·85	123
,, .	Swaffham, The Villa...	2·35	89
Wilts .	Devizes, Highclere......	5·93	255
,, .	Bishops Cannings	5·77	231
Dor .	Evershot, Melbury Ho.	2·35	93
,, .	Creech Grange	3·37	137
,, .	Shaftesbury, Abbey Ho.	3·82	149
Devon .	Plymouth, The Hoe...	2·51	91
,, .	Launceston, Werringt'n	3·25	...
,, .	Holne, Church Pk. Cott.	4·18	119
,, .	Cullompton..............	2·83	105
,, .	Sidmouth, Sidmount...	2·55	101
,, .	Filleigh, Castle Hill ...	4·44	...
,, .	Barnstaple, N. Dev. Ath	3·30	122
,, .	Dartm'r, Cranmere Pool	7·50	...
Corn .	Redruth, Trewirgie ...	3·70	121
,, .	Penzance, Morrab Gdn.	3·15	116
,, .	St. Austell, Trevarna...	4·68	140
Soms .	Chewton Mendip	4·64	133
,, .	Long Ashton	2·72	96
,, .	Street, Millfield.........	2·71	108
Glos .	Blockley	1·93	...
,, .	Cirencester, Gwynfa ...	2·31	89
Here .	Ross, Birchlea............	2·28	100
,, .	Ledbury, Underdown..	2·26	100
Salop .	Church Stretton.........	4·53	185
,, .	Shifnal, Hatton Grange	3·98	177
Worc .	Ombersley, Holt Lock	...	...
War .	Birminghm, Edgbaston	2·53	109
Leics .	Thornton Reservoir ...	2·94	118
Leics .	Belvoir Castle...........	6·59	271
Rut .	Ridlington	4·32	172
Lincs .	Boston, Skirbeck	5·68	258
,,	Cranwell Aerodrome ...	9·89	424
,, .	Skegness, Marine Gdns	·97	45
,, .	Louth, Westgate	2·81	112
,, .	Brigg, Wrawby St. ...	1·96	...
Notts .	Worksop, Hodsock ...	3·16	139
Derby .	Derby, L. M. & S. Rly.	3·77	159
,, .	Buxton, Devon Hos. ...	3·58	91
Ches .	Runcorn, Weston Pt...	4·90	178
,, .	Nantwich, Dorfold Hall	4·14	...
Lancs .	Manchester, Whit Pk.	3·78	115
,, .	Stonyhurst College ...	4·89	126
,, .	Southport, Hesketh Pk	4·42	155
,, .	Lancaster, Strathspey	5·41	...
Yorks .	Wath-upon-Dearne ...	2·63	105
,, .	Bradford, Lister Pk. ...	4·77	173
,, .	Oughtershaw Hall	6·68	...
,, .	Wetherby, Ribston H.	5·73	229
,, .	Hull, Pearson Park ...	1·93	83
,, .	Holme-on-Spalding ...	2·72	...
,, .	West Witton, Ivy Ho.	4·35	165
,, .	Felixkirk, Mt. St. John	6·12	224
,, .	Pickering, Hungate ...	4·92	183
,, .	Scarborough	1·64	67
,, .	Middlesbrough	3·54	138
,, .	Balderdale, Hury Res.	3·46	...
Durh .	Ushaw College	4·14	148
Nor .	Newcastle, Town Moor	3·16	119
,, .	Bellingham, Highgreen	3·17	96
,, .	Lilburn Tower Gdns...	2·83	114
Cumb .	Geltsdale..................	4·56	...
,, .	Carlisle, Scaleby Hall	6·79	207
,, .	Borrowdale, Seathwaite	10·50	133
,, .	Borrowdale, Moraine...	...	...
,, .	Keswick, High Hill...	7·33	...
West .	Appleby, Castle Bank	4·99	158
Glam .	Cardiff, Ely P. Stn. ...	4·10	132
,, .	Treherbert, Tynywaun	8·00	...
Carm .	Carmarthen Friary ...	5·81	165
Pemb .	Haverfordwest, School	3·80	119
Card .	Aberystwyth	4·64	...
,, .	Cardigan, County Sch.	3·52	...
Brec .	Crickhowell, Talymaes	3·80	...
Rad .	Birm W.W. Tyrmynydd	5·25	128
Mont .	Lake Vyrnwy...........	7·10	207
Denb .	Llangynhafal	6·00	257
Mer .	Dolgelly, Bryntirion...	6·59	155
Carn .	Llandudno	3·77	158
,, .	Snowdon, L. Llydaw 9	18·65	...
Ang .	Holyhead, Salt Island	3·60	138
,, .	Lligwy....................	4·06	...
Isle of Man			
	Douglas, Boro' Cem. ...	3·21	105
Guernsey			
	St. Peter P't. Grange Rd.	2·57	127

Rainfall: July, 1932: Scotland and Ireland.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt	Pt. William, Monreith	2·72	97	*Suth*	Melvich	3·49	...
,,	New Luce School	4·01	118	,,	Loch More, Achfary	6·71	65
Kirk	Carsphairn, Shiel	5·89	112	*Caith*	Wick	3·00	114
Dumf	Dumfries, Crichton, R.I	3·12	...	*Ork*	Pomona, Deerness	...	...
,,	Eskdalemuir Obs.	8·29	202	*Shet*	Lerwick	3·33	145
Roxb	Branxholm	3·70	123	*Cork*	Caheragh Rectory	3·89	...
Selk	Ettrick Manse	4·93	111	,,	Dunmanway Rectory	3·10	79
Peeb	West Linton	2·90	...	,,	Ballinacurra	2·85	102
Berw	Marchmont House	2·40	79	,,	Glanmire, Lota Lo.	3·62	125
E.Lot	North Berwick Res.	2·17	84	*Kerry*	Valentia Obsy.	4·72	125
Midl	Edinburgh, Roy. Obs.	1·90	67	,,	Gearahameen	6·20	...
Lan	Auchtyfardle	2·83	...	,,	Killarney Asylum	...	...
Ayr	Kilmarnock, Kay Pk.	4·44	...	,,	Darrynane Abbey	3·17	83
,,	Girvan, Pinmore	5·37	147	*Wat*	Waterford, Gortmore	3·22	101
Renf	Glasgow, Queen's Pk.	3·06	105	*Tip*	Nenagh, Cas. Lough	4·14	132
,,	Greenock, Prospect H.	3·09	79	,,	Roscrea, Timoney Park	5·12	...
Bute	Rothesay, Ardencraig.	4·48	113	,,	Cashel, Ballinamona	4·42	152
,,	Dougarie Lodge	3·54	...	*Lim*	Foynes, Coolnanes	3·54	115
Arg	Ardgour House	12·70	...	,,	Castleconnel Rec.	3·20	...
,,	Glen Etive	...	...	*Clare*	Inagh, Mount Callan	6·71	...
,,	Oban	4·41	114	,,	Broadford, Hurdlest'n.	3·45	...
,,	Poltalloch	4·67	114	*Wexf*	Gorey, Courtown Ho.	3·96	135
,,	Inveraray Castle	7·86	158	*Kilk*	Kilkenny Castle	4·34	154
,,	Islay, Eallabus	4·43	130	*Wick*	Rathnew, Clonmannon	5·28	...
,,	Mull, Benmore	14·80	...	*Carl*	Hacketstown Rectory	5·45	158
,,	Tiree	3·72	...	*Leix*	Blandsfort House	4·54	145
Kinr	Loch Leven Sluice	3·43	119	,,	Mountmellick	...	...
Perth	Loch Dhu	...	...	*Offaly*	Birr Castle	3·69	125
,,	Balquhidder, Stronvar	5·48	...	*Kild'r.*	Monasterevin	...	...
,,	Crieff, Strathearn Hyd.	4·38	147	*Dublin*	Dublin, FitzWm. Sq.	4·27	167
,,	Blair Castle Gardens	4·38	171	,,	Balbriggan, Ardgillan.	4·19	155
Angus	Kettins School	3·74	158	*Meath*	Beauparc, St. Cloud	5·14	...
,,	Dundee, E. Necropolis	3·92	143	,,	Kells, Headfort	4·98	157
,,	Pearsie House	3·40	...	*W.M.*	Moate, Coolatore	3·68	...
,,	Montrose, Sunnyside	3·57	136	,,	Mullingar, Belvedere	4·02	126
Aber	Braemar, Bank	3·78	147	*Long*	Castle Forbes Gdns.	4·49	144
,,	Logie Coldstone Sch.	2·99	101	*Gal*	Ballynahinch Castle	6·04	145
,,	Aberdeen, King's Coll.	3·41	121	,,	Galway, Grammar Sch.	4·65	...
,,	Fyvie Castle	3·25	100	*Mayo*	Mallaranny	6·32	...
Moray	Gordon Castle	2·61	81	,,	Westport House	4·44	143
,,	Grantown-on-Spey	...	...	,,	Delphi Lodge	10·03	151
Nairn	Nairn	...	...	*Sligo*	Markree Obsy.	6·09	177
Inv's	Ben Alder Lodge	4·99	...	*Cavan*	Belturbet, Cloverhill	...	...
,,	Kingussie, The Birches	3·52	...	*Ferm*	Enniskillen, Portora	...	...
,,	Loch Quoich, Loan	9·75	...	*Arm*	Armagh Obsy.	5·25	182
,,	Glenquoich	10·74	167	*Down*	Fofanny Reservoir	7·09	...
,,	Inverness, Culduthel R.	2·87	...	,,	Seaforde	5·08	159
,,	Arisaig, Faire-na-Squir	6·05	...	,,	Donaghadee, C. Stn.	5·54	198
,,	Fort William, Glasdrum	7·99	...	,,	Banbridge, Milltown	4·54	...
,,	Skye, Dunvegan	4·45	...	*Antr*	Belfast, Cavehill Rd.	5·31	...
,,	Barra, Skallary	4·33	...	,,	Glenarm Castle	3·29	...
R&C	Alness, Ardross Castle	2·86	94	,,	Ballymena, Harryville	4·18	122
,,	Ullapool	3·58	113	*Lon*	Londonderry, Creggan	4·92	134
,,	Achnashellach	6·67	...	*Tyr*	Omagh, Edenfel	5·44	160
,,	Stornoway	2·81	...	*Don*	Malin Head	5·14	...
Suth	Lairg	3·48	111	,,	Dunfanaghy	5·41	...
,,	Tongue	4·84	158	,,	Killybegs, Rockmount.	3.73	85

Climatological Table for the British Empire, February, 1932

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1031·5	+15·5	47	25	42·3	33·6	37·9	— 2·2	33·9	84	7·9	0·17	— 1·37	4	1·6	16
Gibraltar	1016·7	— 3·3	64	39	58·6	47·7	53·1	— 2·8	48·1	83	6·7	10·83	+ 6·61	19	..	..
Malta	1016·0	— 0·1	67	41	56·5	48·3	52·4	— 2·9	48·1	77	6·6	5·01	+ 2·81	17	5·9	54
St. Helena	1013·4	+ 0·8	71	59	68·0	60·3	64·1	— 1·8	60·9	92	9·5	1·78	..	18	..	..
Sierra Leone	1012·5	+ 1·7	89	71	86·5	75·5	81·0	— 1·3	76·2	83	4·1	3·74	+ 3·44	3	..	..
Lagos, Nigeria	1010·2	+ 0·5	92	70	88·5	76·2	82·3	— 0·2	76·6	84	4·8	0·44	— 1·46	3	7·1	60
Kaduna, Nigeria	1012·2	— 1·2	99	51	92·3	58·9	75·6	— 1·3	59·9	42	2·6	0·13	+ 0·11	1	9·3	79
Zomba, Nyasaland	1007·0	— 0·9	86	59	80·9	64·3	72·6	+ 0·6	..	74	6·9	5·17	— 5·48	14	..	..
Salisbury, Rhodesia	1010·0	— 0·8	85	53	78·9	59·9	69·4	+ 0·6	63·2	77	7·5	3·85	— 2·97	15	6·2	49
Cape Town	1012·7	— 0·7	101	57	81·5	64·1	72·8	+ 2·5	64·9	76	3·7	2·02	+ 1·44	9	..	..
Johannesburg	1010·1	— 0·7	87	48	75·2	56·1	65·7	+ 0·1	58·1	73	5·4	5·27	+ 0·05	18	7·1	55
Mauritius	1009·2	— 1·8	88	69	84·7	73·2	79·0	— 0·3	75·4	75	6·8	4·46	— 3·94	26	6·4	50
Calcutta, Alipore Obsy.	1012·9	— 0·4	91	53	83·3	60·9	72·1	+ 0·9	61·6	84	2·7	0·25	— 0·74	1*	..	..
Bombay	1012·4	— 0·3	93	65	84·7	69·3	77·0	+ 1·3	66·4	71	1·6	0·00	— 0·03	0*	..	..
Madras	1012·6	— 0·3	92	63	86·3	69·4	77·9	+ 0·2	72·0	81	3·1	0·69	+ 0·39	1*	..	..
Colombo, Ceylon	1011·9	+ 1·1	90	62	85·8	69·9	77·9	— 2·5	74·4	75	3·9	3·59	+ 1·65	7	9·2	77
Singapore	1010·6	+ 0·4	90	70	88·1	72·3	80·2	0·0	75·5	77	6·1	5·12	— 1·50	11	7·6	63
Hongkong	1019·7	+ 1·1	75	44	60·9	53·6	57·3	— 1·8	52·7	75	8·5	2·53	+ 0·70	10	2·7	24
Sandakan	..	..	89	71	85·7	74·2	79·9	— 0·3	75·8	83	..	15·75	+ 4·78	15	..	..
Sydney, N.S.W.	1011·7	— 2·2	101	53	77·9	65·0	71·5	+ 0·2	66·0	67	6·0	5·61	+ 1·41	13	8·2	61
Melbourne	1013·3	— 1·2	93	43	74·8	56·3	65·5	— 2·1	59·2	68	7·1	2·64	+ 0·93	12	5·6	43
Adelaide	1014·5	+ 0·3	97	48	79·4	57·7	68·5	— 5·5	58·4	48	6·0	1·40	+ 0·68	8	7·3	55
Perth, W. Australia	1014·0	+ 1·0	102	55	88·0	65·5	76·7	+ 2·6	63·9	49	3·4	0·00	— 0·45	0	10·1	76
Coolgardie	1013·7	+ 1·2	107	47	92·8	62·2	77·5	+ 1·3	61·2	41	3·0	1·20	+ 0·35	2	..	..
Brisbane	1011·4	— 1·1	94	63	87·5	69·5	78·5	+ 2·0	70·4	61	5·4	0·70	— 5·48	7	9·1	70
Hobart, Tasmania	1010·8	— 2·4	82	44	68·8	53·5	61·1	— 1·2	53·8	60	7·1	1·32	— 0·16	14	5·7	41
Wellington, N.Z.	1012·0	— 3·8	77	48	65·2	54·2	59·7	— 2·9	56·7	79	8·0	6·71	+ 3·57	13	5·2	38
Suva, Fiji	1007·8	0·0	92	70	86·6	75·2	80·9	+ 0·6	76·6	82	7·0	15·24	+ 4·52	23	6·9	54
Apia, Samoa	1008·5	+ 0·1	88	73	85·5	75·0	80·2	+ 1·2	77·3	78	7·5	13·70	— 1·59	19	6·7	53
Kingston, Jamaica	1014·8	— 0·5	89	64	85·5	66·9	76·2	— 0·3	64·4	80	1·7	0·07	— 0·53	2	8·9	77
Grenada, W.I.	1013·6	+ 0·1	88	72	86·7	73·2	79·9	+ 2·8	74·3	76	4·5	2·74	— 0·04	23	..	..
Toronto	1015·2	— 2·8	51	9	35·9	23·2	29·5	+ 8·4	25·5	78	6·9	1·42	— 0·96	7	3·4	32
Winnipeg	1015·9	— 5·9	46	—32	14·6	—3·4	5·6	+ 5·5	..	..	5·2	0·00	— 0·74	0	..	..
St. John, N.B.	1013·2	— 0·7	41	— 4	25·3	9·2	17·3	— 2·6	11·6	65	5·7	0·11	— 3·79	2	4·8	46
Victoria, B.C.	1016·8	+ 0·2	55	20	44·4	36·4	40·4	— 0·1	37·6	86	6·6	6·29	+ 3·03	19	3·9	38

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

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The Hot Weather in England during August, 1932

By LILIAN F. LEWIS, B.Sc.

On Thursday, August 11th, temperature rose to between 80°F. and 90°F. in many parts of England. Subsequently an anticyclone off northern Scotland moved south bringing cool northeasterly breezes on its southern side and temperature dropped almost to normal. Within a week, however, a hot spell of still greater intensity was being experienced in southern England and the Midlands. The southerly movement of the anticyclone continued and on the 16th high pressure extended from the Atlantic across England to Holland. Thereafter a cold front moving slowly south to northern England, the northward movement of a depression over Spain and a small rise in pressure over Germany all contributed to a weakening of the anticyclonic belt over southern England. For a time pressure became very uniform. Widespread fog occurred at times on the 17th and early hours of the 18th. The already warm, almost calm air and abundant sunshine raised the temperature to between 80°F. and 90°F at many places in southern England on the 18th. In France the heat was appreciably greater. Meanwhile a further northerly movement of the depression over Spain and the Bay of Biscay set up a gradient for southerly winds and the warmer air flowed up from France. On the 19th, maximum temperatures above 90°F. were recorded in many places. In London 99°F. was recorded in the Glaisher screen at

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Greenwich and 97°F. at Regents Park and Camden Square. At Kew Observatory the maximum in the screen was only 92°F., but this is the highest temperature reached there since the historic hot spell round August 9th, 1911, when 94°F. was recorded. The maximum of 96°F. at Jersey is a record high temperature there.

Aeroplane ascents at Duxford showed a gradual increase of temperature at 850 mb. (approximately 5,000 feet)—59°F. on the morning of the 17th, 64°F. on the 18th and 72°F. on the 19th. The air between 3,000 feet and 7,000 feet also became increasingly dry, probably due to subsidence. At greater heights there was a corresponding fall in temperature. At 550 mb., or approximately 17,000 feet, there was a drop during the three successive days from 29°F. to 24°F. to 17·5°F., thus giving a very steep lapse rate by the 19th, but the air was still too dry for thunderstorms to develop. The upper winds showed south-easterly or southerly winds up to about 4,000 feet veering to south-westerly above on the afternoon of the 18th and south-westerly from 1,000 feet or 2,000 feet upwards on the morning of the 19th. The temperature, 72°F., at 5,000 feet on the morning of the 19th and 72·5°F. on the afternoon of the same day are the highest ever recorded at that height in this country, exceeding the previous highest, 71°F. on August 27th, 1930. (See *Meteor. Mag.*, 1930, page 176.)

The break occurred under rather complex conditions, cooler air coming in from the north-east over most of the country and from the west in the extreme south. Thunderstorms were delayed in southern England and the Midlands for some time after the cooler air had arrived and only developed during the late evening or night of the 20th. In southern Ireland the storm began in the morning of the 20th and in a belt across northern Ireland, northern England and southern Scotland in the afternoon or evening. In London the storm was observed to travel from south to north and there was a brilliant display of lightning. The fall in temperature was very sudden in the Midlands where the maximum on the 20th was more than 20° lower than on the 19th. At Birmingham the drop was from 91°F. on Friday to 66°F on the following day, a difference of 25°. By Sunday, the 21st, a new anticyclone, which developed off the north of Scotland began to spread southward and with it the front between the North Sea air of polar origin and the warmer air round the low-pressure areas to the south. On Monday this front had reached southern England and the maximum at Greenwich was only 68°F. as compared with 99°F. on the previous Friday. Some notable high minima were 70°F. at Croydon on the 19th and 73°F. at Lympne on the 20th. The reading at Croydon is the highest since observations were started there in 1920 and the one at Lympne is probably the highest minimum recorded in the British Isles, being one degree higher than that registered at Ventnor on July 13th, 1923.

The areas chiefly affected by the heat were the southern, eastern and Midland districts of England. In Scotland and northern Ireland maximum temperatures on the 18th and 19th ranged mainly between 60°F. and 70°F. but on the 17th 74°F. was recorded at Aberdeen, 73°F. at Berwick-on-Tweed and 73°F. at Donaghadee.

It is interesting to compare conditions during this warm spell with the warmest experienced in London, namely that of August, 1911. In the latter case the Continental anticyclone was further north over Denmark and had moved in from the south-west, while pressure was persistently low over Iceland and a shallow trough moved eastward from the west of Ireland and the Bay of Biscay, bringing in light southerly breezes and warm continental air. In that case the trough apparently passed over London and south-east England without giving thunderstorms, although one occurred at Nottingham, thunder and lightning occurred at Birmingham and lightning was seen at Greenwich.

The following temperatures, observed at intervals of half-an-hour, were recorded at Kew Observatory on August 19th. The corresponding computed relative humidities are also given. The Assmann psychrometer was suspended at the eastern end of the Stevenson screen, 4 ft. above the ground. The values given are means of several readings extending over a period of 3 minutes centred at the times indicated.

Time G.M.T.	h.m. 11 15	h.m. 11 45	h.m. 12 15	h.m. 12 45	h.m. 13 15	h.m. 13 45	h.m. 14 15	h.m. 14 45	h.m. 15 15	h.m. 15 45
	Air temperature									
	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F
Assmann	92·5	93·1	93·5	93·9	93·1	93·5	93·3	92·1	91·4	90·9
Stev. screen	91·9	92·9	93·3	93·7	93·2	93·3	93·1	93·2	91·5	90·9
North wall screen	88·7	89·6	89·6	90·7	90·7	91·3	91·1	91·1	90·3	90·5
	Relative humidity									
	%	%	%	%	%	%	%	%	%	%
Assmann	45	44	39	41	44	40	41	45	41	39
Stev. screen	42	42	37	37	36	38	37	36	37	36
North wall screen	50	50	48	46	46	45	45	42	44	43

It should be noted that the north wall screen is at the abnormal height of 10 feet above ground, while the Stevenson screen is on the lawn to the south-west of the building and exposed in accordance with standard Meteorological Office practice.

At South Kensington the temperature at 14h. 4m., G.M.T., on August 19th on the roof of the Meteorological Office about 60 feet above street level, as recorded by an Assmann electrically ventilated thermometer was 97.9°F. On the previous hot day, August 11th, the following interesting records of temperature were obtained at South Kensington with an Assmann thermometer about 15h., G.M.T.

	°F.
On the roof	87
At street level, Imperial Institute Road—	
Sunny side	88
Shady side	86

These figures indicate that air temperature on the roof is about 1°F. below air temperature in the street on the sunny side and 1°F. above that on the shady side and that a decrease in temperature of 2°F. occurs on crossing from the sunny to the shady side of the street.

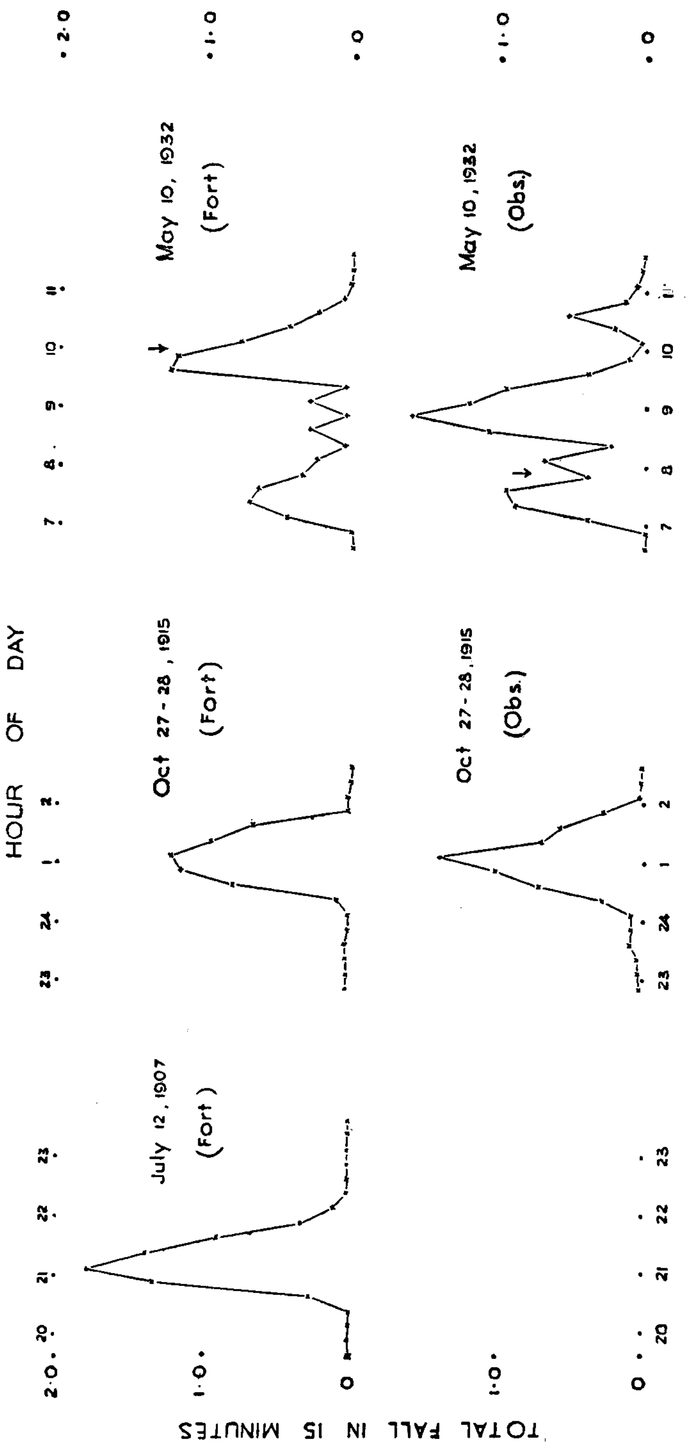
Heavy Rain at Colombo on May 10th, 1932

By H. JAMESON, B.Sc.

A rainstorm at Colombo on the morning of May 10th, 1932, which was one of the heaviest ever recorded by either the Observatory or the Fort pluviograph, presents some interesting features. Almost 10 inches of rain fell at the Observatory between 7 and 11 a.m., of which 9 inches fell in about 3 hours.

Unfortunately both the Fort and the Observatory traces are defective, as in each case the chart had to be changed during the storm, and the records at the commencement of the new charts are affected by backlash. Moreover, in the case of the Fort trace, the observer, who has to cycle down from the Observatory to attend to the observations, was considerably delayed by the torrential rain, with the result that the pluviograph pen had run off the paper on to the metal clip, except in the centre of the curved stroke, by the time the chart was changed. A third pluviograph, which had been sent in to the Observatory from an outstation for overhaul, happened to be left partly exposed to the rain, and its record, though imperfect, was sufficient, with the help of some experimental observations on the Observatory drum, to afford an approximate correction for the backlash on that trace.

The rain falling during each quarter of an hour has been measured up on each trace. Although the traces are imperfect, and the apportioning of the rain to the correct time intervals is difficult when the strokes are so crowded together, the figures give a sufficiently accurate idea of the main variations in the rainfall during the storm. These figures are plotted in the diagram, with corresponding figures for two other storms, which a rapid inspection of the pluviograms in file (Fort, 1898 to date; Observatory, 1909 to date) showed to be most closely comparable with it. No correction has been made in these curves for clock



RAINFALL IN INCHES RECORDED EACH QUARTER OF AN HOUR BY COLOMBO PLUVIOGRAPHS DURING SOME INTENSE STORMS.

rate or difference from standard gauge, of which there is one near each pluviograph. Such correction would not be more than five per cent., at the outside. An arrow shows the time, during the storm of May 10th, 1932, when the charts were changed.

The Fort pluviograph is on the roof of the Surveyor-General's Office, 70 feet above the ground, and, on account of its position, it underestimates very much the corresponding rainfall on a ground site. From comparisons with other gauges in Colombo, the correction to yearly totals must be of the order of twenty-five per cent., and though it is impossible to give definite corrections for individual storms, it is safe to say that such corrections will be appreciably positive.

The rainfall during this storm was very local, the heaviest falls being concentrated in the southern and central districts of Colombo. The rain recorded by the Fort pluviograph, which is 2½ miles north-west of the Observatory, between 7 and 11 a.m., was 7.10 inches, which may correspond to a ground reading of about 9 inches, and the only rain-gauge stations which recorded comparable falls during the two rainfall days, May 9th-11th, were Maligakanda, about 1¼ miles north, and the Training College, about 1 mile west, of the Observatory.

The general weather conditions over Ceylon about this time wore not unusual for May. The flattish barometric gradients that are typical of the intermonsoon season about this time of year were in evidence during the first few days of the month. On the 9th and 10th, however, there was a more definite, though still weak, south-westerly gradient over the island. This had died down by the 11th, and intermonsoon conditions continued till the 16th, when the weak south-westerly gradient reappeared, and normal monsoon conditions set in definitely over Ceylon about the 18th.

When south-westerly monsoon currents first appear near Ceylon, the check at the coast must be considerably more effective than later on in the monsoon, as there is not only the difference between the friction of the sea and land surfaces, but also the inertia of air currents, that form local circulations over the island during the intermonsoon period, to be overcome. This affords a reasonable explanation of a tendency for rain to fall near the coast at the outset of the monsoon, rather than at the more solid obstruction formed by the hills further east.

The storm of May 10th must have been caused by this coastal check to the on-coming monsoon winds, though its unusual intensity was probably fortuitous. The anemometer charts at the Observatory, and at the Pilot Station in the Harbour, 3½ miles to the north-west, are of distinct interest. The wind during the previous 24 hours was fairly light (averaging about ten miles per hour at the Pilot Station, where the exposure is unusually open), and generally south-easterly. Occasional changes to a westerly direction were usually associated with rain. On the other hand, the general direction of the wind reported from ships at sea near the island was westerly, and most of the Ceylon coastal stations reported westerly to southerly winds. At Colombo the day (9th) was dull and overcast, with low day temperatures and high relative humidity, but the absolute humidity was appreciably lower than it had been for several days before. The observations suggest opposition between a local south-easterly wind and the westerly monsoon currents forcing it backwards or upwards.

After 7 a.m., on the 10th, when the heavy rain started, wind directions became very variable, and there were some marked differences between the directions recorded at the same time by the two anemometers. Although the rain-storm started and ended at practically the same time at both the Observatory and the Fort, the really heavy precipitation was nearly an hour later at the latter station. The opposing air currents were presumably entangled in a swirl, which would be complicated by the mechanical and thermal effects of the heavy rain.

Correspondence

To the Editor, *The Meteorological Magazine.*

Extremes of Heat in August

Commenting recently on the late date, August 19th, 1932, two months from the longest day, for a temperature of 99° at Greenwich, the meteorological correspondent of an important newspaper assumed that, had precisely similar meteorological conditions occurred in July, the temperature would have exceeded 100°F. But this seems to me to some extent to beg the question, inasmuch as experience does suggest that August, though averaging a little cooler than July, is actually the month for spurts of extreme heat corresponding to the liability of February to acute frost. That heat in August is commencing to leak out is very evident in the cooler types of August weather; but it should be remembered that with respect to July, the warmth has penetrated deeper into the soil, diffused higher into the atmosphere, and accumulated to a maximum in the sea. All these factors are conducive to very high temperature in August under certain conditions, and the best combination for extreme heat is probably more likely to occur in August than in July when the average warmth, though reaching a maximum in the surface of the soil and lower layers of the atmosphere, is less widely diffused.

Similarly it is only when one remembers these factors of accumulated warmth that the severity of September heat waves with the sun down to half-strength, becomes intelligible.

The peculiarly enervating character of August heat is probably connected with the fact that the vapour pressure tends to be highest in a month when the seas round Britain are warmest. An intense August heat wave is also associated with an impressive hush over the countryside, for it is the month of the year when the birds are most silent.

L. C. W. BONACINA.

35, *Parliament Hill, London, N.W.*3. *August* 22*nd.*, 1932.

Unusual Thunderstorm Phenomena

Having read some accounts of lightning phenomena in past numbers of the *Meteorological Magazine,* I think the following may be of some interest to your readers.

Last night (August 20th) there were thunderstorms all around here from 9 p.m. till 12.30 a.m. (B.S.T.). At about 10.50 p.m. there was a very severe and complex lightning discharge almost immediately overhead. It was followed almost immediately by a sharp click, and then, after an appreciable pause, by a loud and prolonged clap of thunder. The click reminded me of a shot fired by a rifle on a miniature range. Rain was falling steadily but not very heavily at the time, and I do not think anything was struck.

Other discharges as near and even more severe were not followed by a click.*

DONALD WATERER.

Stanfield, Ferndown, Dorset. *August* 21*st*, 1932.

Heavy Rainfall and Flooding in Unst, Shetland

On Sunday morning, July 31st, there occurred a very heavy rainfall with flooding and damage. Saturday was rather dull with light winds but no appearance of rain. At about 22h. 30m., G.M.T., there was a slight drizzle, increasing later to a moderate rainfall. At about 5h. on Sunday there was a sudden downpour which continued until about 7h. We have no rivers or large streams in the Island of Unst, but the streams became in a very short time raging torrents, in many cases they rose seven to eight feet above their normal level. Footbridges and fences were carried away, fields of oats destroyed, roads destroyed, and large quantities of earth shifted forming new gullies on the hillside. By noon, most of the flooded areas were clear of water. I do not remember ever having seen in Shetland such a downpour in such a short time and the " oldest inhabitant " says he never remembers the like. Is the " oldest inhabitant " always to be relied upon? The amount measured on the morning of July 31st was 2·34 in.

T. EDMONSTON SAXBY.

Baltasound, Unst, Shetland. *August* 3*rd*, 1932.

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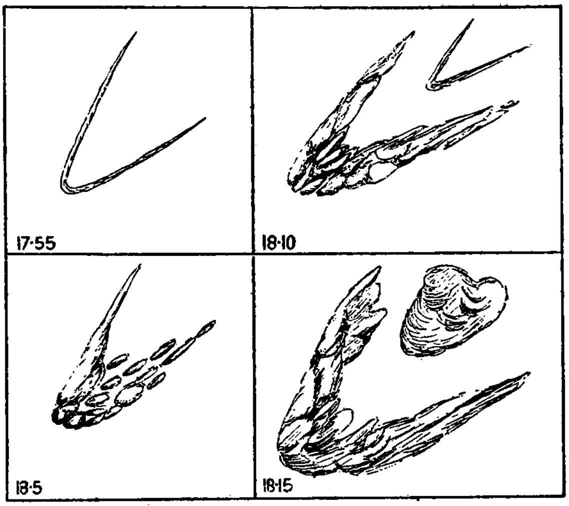
* A discussion of this phenomenon will be found in the *Meteorological Magazine* 63, 1928, p. 113 and p. 162.

Unusual Cloud Formation

I saw a most interesting and I believe unusual type of cloud formation last evening, August 30th, from 17h. 55m. to 18h. 15m. (G.M.T.) Directly to the south of this station, there appeared in the sky at 17h. 55m. what appeared to me to be the exhaust fumes from an aeroplane, but as I had not seen or heard an aeroplane within at least seven hours, I knew that it must be a rather singular type of cloud formation. When I first observed it, it was a very fine streak in the sky. It was moving very slowly towards the east, and at 18h. 5m. it widened gradually from the base upwards to the top of the cloud forming into cirro-cumulus cloud. At 18h. 10m. approximately, another streak formed directly in line with the one just referred to, to the west of it. At 18h. 15m. this second streak appeared to roll and it finally formed into a round mass of cumulus.



T. F. Prosser.

Royal Agricultural College, Cirencester. August 31*st*, 1932.

Parhelion or Paraselena

While at Grayshott on August 16th I witnessed the following phenomenon. At 20h. 8m. the sky was half clouded with fairly dense cirrus, and looking up to a point about 43° from the horizon and 190° from the north there was a colourless patch of light exactly the size of the sun or moon when observed at that altitude. I took it first for a local thickening of the cloud, but the rate of cirrus movement was roughly 5° in 10 minutes and the patch of light appeared stationary while the clouds moved. The illumination was uniform over the area in question but around it the cloud was fibrous in texture. It was definitely not due to a star, as no bright star occupied that position at the time of observation and I could not explain it on the ground of artificial production. The only theory left is that it was in the nature of a parhelion or paraselena, but if this is the case it must have been an extraordinary one. The sun set at 19h. 19m., G.M.T., and the moon (full then) rose at 19h. 40m., so that the phenomenon cannot have been a mock-sun or moon associated with any known halo. The light persisted until 20h. 21m., when it was scarcely visible. Measurements were made with a circular protractor.

S. E. ASHMORE.

22, Soho Road, Handsworth, Birmingham. August 31*st*, 1932.

Tornado in Sussex

At 5.29 p.m. (B.S.T.) to-day, I saw what appeared to be a cone of cloud descend from the edge of a large storm cloud. This cone was due north from this station and I should say, about 8 miles away. It appeared to grow rapidly larger and quickly descended to earth, being bent back towards the west and twisting round and round. All the time it was moving along very rapidly towards the north-east. Finally, after 3 minutes, it broke up from below and rapidly disappeared. It had all gone by 5.33 p.m., but in that time it had moved through about 10°.

There was a very large storm cloud present at the time stretching from south-west to north-north-east. A storm was raging about 5 miles west from here between 3.30 p.m. and 7.30 p.m.

On investigation I found about 10 miles north-north-east from here, near Wych Cross in the Forest (Ashdown) a trail of two fallen trees and many broken branches. Bushes and grass in the neighbourhood had been flattened, and there was a small amount of hay on some of the gorse for about 200yds.

LESLIE S. WOODHEAD.

The Gables, Barcombe, Lewes, Sussex. July 26*th*, 1932

[At Wych Cross itself there was a sudden thunderstorm about 6 p.m. which lasted about 20 minutes. It was accompanied by heavy rain but very little wind.—ED. *M.M.*]

NOTES AND QUERIES

The Thunderstorm of August 12th, 1932

For the second time within three weeks, the Rickmansworth and Chorley Wood district of Hertfordshire was visited by a thunderstorm of unusual severity early on Friday, August 12th. The storm approached rapidly from south-south-west over an easterly surface wind, breaking, it is believed, after only a single preliminary thunderclap. Increasingly heavy rain began at 4h. 55m. G.M.T., and from 5h. until 5h. 30m. the fall maintained a persistence of intensity unparalleled in the writer's twenty-seven years' experience of meteorological observing in England and abroad.

After about 5h. 2m. the deluge was accompanied by nearly continuous hail. The stones were spheroidal, and appeared to average 0·5in. in diameter, but were in some instances amalgamated into masses approximately the size of a golf ball. To save the radiation thermometers from destruction, a journey that will not readily be forgotten was made to the instrument enclosure at 5h. 5m. The assault of ice and water can only be described as terrific. At 5h. 30m. the hail ceased abruptly, and there was a progressive slackening of the rain. By 5h. 40m., when the gauge was examined, the fall was over, except for 0·01in. The measurement for the 45 minutes from 4h. 55m. to 5h. 40m. was 2·24in.—an amount that may well have been short of the true figure by reason of the hailstones rebounding from the funnel of the gauge. Both before 5h. and after 5h. 30m. the rain was not of outstanding violence, and it is estimated that of the measured total of 2·25in. yielded by the storm, nearly, if not quite, 2in. must have fallen within the half-hour.

The lower part of the garden and the adjoining country road, in common with most of Rickmansworth town, were flooded to varying depths, and a great deal of damage was done locally in this way. Throughout the morning fire engines were at work pumping water out of the ground floors of houses in the main street.

During the period of torrential rain there was an extraordinary purplish-copper tinge in what little light remained in the sky. The cloud-base appeared to descend to the tops of the surrounding hills (80ft. to 120ft. above station level and 260ft. to 300ft. above M.S.L.). Thunder, though never excessively loud, was almost continuous from 5h. to 5h. 30m., and a count of lightning frequency made between 5h. 10m. and 5h. 15m. gave 35 to 40 flashes per minute. The impression was gained that discharges of the cloud-to-cloud type predominated.

A remarkable feature of the storm was its association with a rapid increase of air temperature. Notwithstanding the extremely heavy character of the hail and rain, the thermograph at about 5h. showed a sudden rise of 5°F. from 59°F. to 64°F., followed by a very slow decline to 63° towards 6h. These changes were confirmed by eye observations of a thermometer exposed at a window under shelter. The suggested explanation is that a pool of chilled, stagnant air, such as normally forms in this cup-shaped valley under a clear night sky (which had prevailed prior to the approach of the storm), was suddenly displaced by turbulence at the onset of the out-blowing squall accompanying the arrival of the great cumulo-nimbus cloud overhead. Downward transfer of heat by eddy motion presumably led to sudden abolition of the nocturnal inversion, and immediately raised the air temperature at the valley bottom to approximate equality with that obtaining on the neighbouring high ground. The screen minimum in the early hours had been 57° compared with 65° at Kew and Hampstead, the nearest stations from which reports are at present available.

There is evidence that the storm water percolated through the soil (sand and gravel over chalk) to a depth of 4ft. within four hours after the cessation of the rain. At 9h. the 4ft. earth thermometer read 62·2°F., 1·2°F. above the highest point hitherto registered since the instrument was installed in May, 1929. On the day preceding the storm the 9h. reading had been 60·7°F. The rise of 1·5°F. in 24 hours was more than twice as great as had been recorded within a similar interval on any previous occasion. Although the grass plot in which the thermometer is sunk had been extensively flooded, the close-fitting cap had kept the interior of the iron containing tube perfectly dry; it thus seems necessary to infer that the unprecedented increase in the 4ft. subsoil temperature was due to sudden conveyance of heat from the warm upper strata of the ground (the 6in. and 1ft. earth thermometers read 66·5°F. and 66·3°F. respectively) by infiltration of the flood water.

E. L. Hawke.

The following remarks on the synoptic situation associated with the thunderstorm described by Mr. Hawke have been kindly supplied by Captain C. K. M. Douglas, B.A., of the Forecast Division of the Meteorological Office :—

" The storm was associated with a typical summer cold front, a very warm southerly current being displaced by a cooler southwest current. The sequence of developments was of a normal type. On August 11th there was a warm SE. wind behind a retreating anticyclone over Germany, and a spell of fine warm weather culminated in a hot day, the maximum temperature at Kew being 88°F. A SSW. wind was accompanied by a slight fall of temperature at high levels, temperature at Duxford having fallen 3° to 4°F. since the previous day above 10,000 feet, but having risen at lower levels. Associated with this increased lapse-rate, alto-cumulus castellatus clouds were visible late in the day in south-east England. The lower air was still too dry for thunderstorms, and the relative humidity at Duxford at noon was between 20 per cent. and 33 per cent. from 5,000 to 10,000 feet. The dryness at these levels may be attributed to subsidence in the anticyclone rather than to the continental nature of the air. By next morning the humidity in the upper air had risen decidedly, a new air mass having come over during the night, belonging to the straight southerly current outside the anticyclone. Pilot balloon ascents just ahead of the front showed a wind from just west of south from 1,000 feet upwards. The Duxford aeroplane ascent was made at 6h. 15m. G.M.T., just before the storm arrived, and the pilot was obliged to land at Martlesham. The observations are thus of special interest. They showed an inversion below 1,000 feet and an isothermal region to 1,700 feet, and then a slowly increasing lapse-rate. At 3,200 feet the temperature was 68°F., or 18°F. above the August normal, whilst at 19,000 feet it was 10°F., only 7°F. above normal. The lapse-rate in the intervening layers was well above the saturated adiabatic rate, but was nowhere up to the dry adiabatic rate (at least when averaged between the levels where observations were taken, roughly every 1,600 feet). Probably the thrust of the under-cutting cold air was necessary to form clouds and so start the disturbance. Another ascent was made at 12.15 G.M.T. behind the cold front, and temperature had fallen from about 2,000 up to 12,000 feet, the fall being 6°F. from 3,000 to 6,500 feet and 4°F. at 10,000 feet.

The Rickmansworth storm was probably the same one as crossed South Farnborough, travelling in a south-south-west upper current of the order of 30m.p.h. Part of the same chain of thunderstorms moved rather slowly from west to east across London. The individual cumulo-nimbus clouds moved rather quickly from south-south-west and had a rather high base; a squall cloud moved from west a little lower down, but did not appear to be much below 4,000 feet. At Kingsway the cold front, as shown by wind and pressure, arrived at 5h. 30m. and temperature rose from 70°F. to 72°F. This point is covered by Mr. Hawke's remarks above. Though the London temperature was much higher than at Rickmansworth there was doubtless a small inversion. The heavy rain with the storm arrived at 6h. 40m., and the temperature fell to 70°F. The storm produced the characteristics of a second cold front, but this was probably due to the rain, and the interval of 70 minutes between the first front and the storm was probably due to a fair depth of cold air being required to start off the storm in the early morning.

It is probable that the portion of the storm belt which crossed London had only recently developed. Lightning and a little thunder were observed much earlier in the night to south and south-west of London. An observer a few miles south-west of Dorking first saw lightning far to south-south-west at 22h. A single near flash to earth accompanied a shower at 2h., but the storm then died out. A slight storm reported before 1h. at Calshot, before the front arrived, was probably one of these early storms. No further rain or loud thunder occurred in the Dorking area.

The storm was fairly widespread in eastern England, but the west seems to have largely escaped. It was widespread in Scotland and northern Ireland and (according to reports in the Press) was severe in many places. These northern storms were not due to the same cold front as those in England, but were associated with the same irregular shallow depression, and with part of the same south-south-west upper current, in which the lapse-rate of temperature was probably high over a large area.

The following extracts from observers' notes indicate the progress and intensity of the storm in the London area:—

(*Victoria.*) Much thunder beforehand; rain very heavy to start with, then only moderate rain and occasional thunder. No hail observed. The heavy rain lasted only a short time.

(*Clapham-Kingsway.*) No thunder nor rain noted at Clapham up to 6h. G.M.T. Large drops—splash size of half a crown—observed at Elephant and Castle at 6h. 15m. G.M.T. Rain slight—began in Kingsway at 6h. 25m. G.M.T.

(*Kingsway-Norwood.*) Increasing heavy rain at Kingsway about 6h. 45m. G.M.T. Very heavy about Kennington. By 7h. 30m. precipitation had stopped at Norwood. Hailstones found in garden at least 10 minutes after cessation of storm of ½ inch estimated diameter. Some of the larger hailstones estimated at ¾ inch diameter and flattened. Some of the smaller hailstones were quite clear and were apparently simply frozen water-drops.

(*Wallington.*) Heavy rain, with some hail, for about 20 minutes round about 6h. 30m. G.M.T. Hail in no way remarkable. Rumbling thunder for an hour or so beforehand.

(*Motspur Park, New Malden.*) The approach of this storm was noted at 6h. 10m. G.M.T. apparently coming up the Thames Valley towards London. There was, however, another smaller storm centre to the south-east, but the two centres did not seem to connect in any way. The main storm skirted this district and heavy rain fell for only 5 minutes, 6h. 20m.—6h. 25m. No hail was noted, but the storm passed much closer to Wimbledon, which is about 1½ miles north-east of this district, where heavy rain and hail did some damage.

(*Highbury.*) Hailstones observed to be quite ½ in. in diameter.

Mr. M. O'Connor, an observer at South Farnborough meteorological station, describes the storm and associated phenomena as follows:—

MOCK SUNS FOLLOWING A HEAVY THUNDERSTORM.

A heavy thunderstorm with unusually large hail occurred here about sunrise on the morning of August 12th, 1932. An optical phenomenon consisting of a counter-sun and mock sun was observed following the storm, which in view of the unusual position of the mock sun, may be of general interest.

It had been a thundery night. Lightning was first noticed about midnight, and a storm occurred at 1h. 40m. G.M.T. and lasted about an hour. A much heavier storm first heralded its approach from the south-west at 4h. 10m., and was at its height from 4h. 45m. to 5h. Heavy hail occurred from 4h. 46m. till 4h. 57m., the hailstones measuring ½ to ¾ in. in diameter during the first part of this period. More than one local resident states that still larger hail fell in the last minute of this period and in one case eight hailstones placed end to end covered 10 in. The hail was observed to consist of a solid opaque nucleus surrounded with a layer of clear ice 1/16 in. thick in the case of the smaller stones.

At 5h. 5m. the storm was moving away north-eastward; blue patches in addition to much false cirrus were visible in the zenith. Further broken cumulus at 4,000 ft. was observed to the south-west at 25° elevation and alto-cumulus associated with alto-stratus at about 8,000 ft. was visible at a greater distance in the same direction.

As the sun in the east was breaking through the cumulonimbus which was passing away north-eastward, an unusual red colouring of the broken cumulus to the west-south-west attracted attention. A small portion only of the cumulus was so coloured, and the manner of the colouring suggested that the refracted rays were coming from behind the cloud. As the broken cumulus advanced in a north-easterly direction, an unusually bright white counter-sun became visible in the place of the coloured cumulus and against a background of the more distant alto-cumulus. After a few minutes, a white mock sun appeared at the same elevation as the counter-sun in a position 30° south of the latter. No arcs of contact or other halo phenomena were visible. The counter-sun faded at 5h. 22m. and the mock sun some three minutes later.

The Swan Song of the Radcliffe Observatory

It has been the custom of the Trustees to issue every five years a neat volume containing the results of the meteorological observations made at the Radcliffe Observatory, Oxford, printed *in extenso*. These volumes have been very welcome additions to our shelves, not only on account of the observations themselves, but because they frequently contained appendices giving valuable summaries of the previous observations or accounts of special investigations.

The last volume of the series was recently issued. It contains the daily observations for the years 1926 to 1930, and an Appendix by Dr. Knox Shaw and Mr. J. G. Balk, which is one of the most useful and interesting things of its kind that has ever been published. The authors have gone over the whole of the Radcliffe observations with a critical eye, and by applying corrections necessitated by changes of instruments or exposure have produced a homogeneous set of serial monthly values for each element, going back to the earliest date for which comparable data are available. In some cases data are available for earlier years, but the authors have done wisely in excluding from the tables, years in which the necessary corrections could not be applied with confidence. They have given us tables of pressure, wet bulb temperature, maximum temperature, minimum temperature, grass minimum temperature, wind velocity, sunshine and cloud percentage back to 1881 and of rainfall and dry bulb temperature (daily mean) back to 1815. For the two latter elements there are also tables of period means, first for the six years 1815-1820, and then for decades.

There is perhaps nothing more stimulating to anyone with a taste for climatology than to see a table which shows at one glance the whole history of a particular element over a long period, and one may safely prophesy that references to this volume will be numerous in future papers. The following are a few facts derived from the tables :—

Temperature.

The ten-year annual mean has varied over a range of about 1°F.; highest (1821-30), 49.5°F.; lowest (1881-90), 48.4°F.

In January the ten-year mean has varied between 36.6°F. in 1821-30 and 40.7°F. in 1921-30; the thirty-year mean has varied between 37.2°F. in 1821-50 and 39.7°F. in 1901-30. In July, however, the thirty-year mean has only varied between 61.0°F. in 1821-50 and 61.6°F. in 1851-80.

The greatest variability of monthly mean temperature occurs in December, January and February, in all of which the mean for the warmest month is more than 17 degrees above the mean for the coldest month. The least variability (under 10 degrees) occurs in August and September.

The warmest month of any name was July, 1921 (mean temperature 67·5°F.) and the coldest, February, 1895 (mean temperature 28·5°F.). The mean maximum in July, 1911, and July, 1921, was 79·1°F.; the mean minimum in February, 1895, was 22°F.

Absolute maximum (August, 1911)	94·9°F.
,, minimum (January, 1881)	5·9°F.
,, grass minimum (February, 1917) ...	–2·4°F.

Sunshine and Cloud.

Highest monthly total of sunshine (July, 1911)	310·4	hours
Lowest ,, ,, ,, (December, 1890)	5·0	,,
Sunniest year (1899)	1,809·6	,,
Least sunny year (1888)	1,158·3	,,

It is of interest to note that these were not the years of minimum and maximum cloud percentage. The cloudiest year was 1897 with 72 per cent. and the sunshine in that year was not only well above the normal but actually higher than in the least cloudy year (1918) with 59 per cent.

The cloudiest months are January and December (72 per cent.) and the least cloudy September, (60 per cent.) and May (62 per cent.). The mean cloudiness is 66 per cent. a figure which is exactly equal to 100 minus the mean percentage duration of bright sunshine.

Rainfall.

Wettest month of any name (July, 1852) ...	7·60 in.
Driest ,, ,, ,, (February, 1891) ...	·01 in.
Wettest year (1852)	40·73 in.
Driest ,, (1921)	14·94 in.
Wettest decade (1871-1880)	27·56 in.
Driest ,, (1891-1900)	23·09 in.

There is only one point which calls for criticism, and that is the absence of any statement regarding the terminal hour to which the tables of mean maximum and mean minimum temperature refer. There appear to have been at least two changes in the hours of reading and setting the thermometers and each of these changes must have had some effect on the mean values of daily maximum and minimum. It is known, for example, that in winter months at an inland station the mean minimum for 24 hours ending 9h. may be something like 1°F. lower than the mean minimum for 24 hours ending 21h. This particular change of setting hour occurred at the Radcliffe Observatory at the end of 1924 and unless the results have been manipulated in some way to take account of such changes the tables are not strictly homogeneous.

This is the last Radcliffe volume we shall see. The observations are being continued so long as the staff remain in the building but they will cease when the impending move of the Observatory from its present site materialises. Arrangements have been made to ensure, as far as possible, that climatological observations will continue to be made in Oxford and summaries will be published in the *Monthly Weather Report*. We must, however, reconcile ourselves to the fact that we have concluded an important chapter in the history of British climatology, in the annals of which the volumes of Radcliffe observations must for ever hold an honoured place.

E. G. Bilham.

Books Received

Annali del R. Ufficio Centrale di Meteorologia e Geofisica Italiano. Ser. 3. Osservazioni, 1922. Ministry of Agriculture and Forestry. Rome, 1931.

The katabatic winds of Poona, by S. Atmanathan, M.A. India Meteor. Dept. Sci. Notes, vol. iv, No. 40. Calcutta, 1931.

Obituary

Herbert George Watkins.—We regret to learn of the death of Mr. H. G. Watkins, leader of the Greenland Air Survey Expedition, who disappeared from his kayak while seal hunting in Lake Fiord, north of Angmagsalik in east Greenland, on August 20th, and was almost certainly drowned. Although so young—he was born in 1907—he had already led three expeditions to Arctic regions. He entered Trinity College, Cambridge in 1925, and in 1927, when only 21, he was chosen leader of the University expedition to Edge Island, Spitsbergen. In 1928 he himself organised and led a party to explore the almost unknown interior of Labrador. The success of these two efforts led to his selection as leader of the British Arctic Air Route Expedition to Greenland in 1930-1, one of the most ambitious explorations of recent years. Its purpose was to explore the Greenland ice cap with a view to the establishment of an air route from Great Britain across the Arctic to Canada, and one of the main objects was the collection of meteorological observations, at sea level, on the ice cap and by aeroplane in the upper air. The observations on the ice cap were continued throughout the winter, Courtauld remaining alone at the station from December 6th to May 5th. A preliminary survey of the important results achieved, covering a period of nearly a year, was compiled by Mr. S. T. A. Mirrlees and published in the *Geographical Journal* for July. Mr. Watkins' own account of the general results of the expedition appears in the *Geographical Journal* for May and June, and contains many graphic descriptions of the weather. In June, 1932, Mr. Watkins was awarded the Founder's Medal of the Royal Geographical Society for his Arctic explorations; he was the youngest recipient of any of the Society's gold medals.

In July of this year Mr. Watkins left England to continue his mapping of east Greenland, and established a base at Lake Fiord. The news of his death, which came as a great shock, for he was expert at handling a kayak, called forth many tributes to his qualities of enterprise and leadership, both at home and abroad.

James Edward Crombie.—Dr. J. E. Crombie, who died on August 6th, 1932, graduated M.A. at Aberdeen University in 1882. Though he chose a business career instead of an academic one, he never lost touch with the University and during his lifetime he became one of its greatest benefactors; he placed his services ungrudgingly at its disposal, and took the deepest personal interest in its welfare. He filled the posts of Rector's Assessor and Chancellor's Assessor, and was a member of the University Court and all its departmental committees. For his valuable services to the University the Senate conferred upon him the degree of LL.D. in 1907. The various hospitals and convalescent homes in Aberdeen and its neighbourhood have likewise reason to be grateful to Dr. Crombie for his generosity and personal assistance in their development.

Dr. Crombie's hobbies showed a distinctly scientific bias. He was keenly interested in ethnology and was a Fellow of the

Royal Geographical Society. At his lovely home in Parkhill he maintained, for his private information, a small meteorological station with thermometer screen, rain-gauge, and sunshine recorder; and in 1914 he had a Dines pressure-tube anemograph installed in the woodland part of his estate in order to test the effect of trees upon the wind velocity. The head of the instrument is 75 feet above the ground but only 15 feet above the tree-tops, and the records obtained demonstrate a very gusty exposure.

Dr. Crombie was always greatly interested in meteorological matters, and for a number of years he was a member of the Edinburgh Meteorological Office Advisory Committee. Seismology, too, claimed a good deal of his spare time, and he maintained successively several different patterns of seismographs in constant operation, the last one being of the Shaw-Milne pattern.

Personally, Dr. Crombie was the most charming of men, kindly, courteous, and modest to a marked degree. He hated anything approaching publicity, and what he did do was done unostentatiously and for the love of the doing. To quote from the *Aberdeen Free Press*—"Few men have served public life more unselfishly than Dr. Crombie, or with less thought of the personal reward it might bring."

G. A. Clarke.

The Weather of August, 1932

Pressure was above normal over the North Atlantic, Europe, northern Asia, northern Africa and California and Alaska. Areas over south-west Scandinavia and eastern Russia and Siberia had an excess greater than 5 mb. the greatest excess being 9·6 mb. at Ekaterinburg. Elsewhere in North America and in the Arctic pressure was below normal, the greatest deficit being 6·9 mb. at Spitsbergen. Temperature was generally above normal, it was normal in northern Sweden and was below normal in Portugal. Rainfall was generally deficient (as much as 70 per cent. in north-western Gothaland) but was in excess in northern Norway.

Over the British Isles the weather of August was mainly anticyclonic with breaks about the 11th, the 20th and at the end of the month. The outstanding characteristic was the heat over a large part of England (see p. 177), the nights, especially, being very warm. At Ross-on-Wye it was the warmest August since 1911 and at Lympne the warmest since the observations began in 1920. Rainfall was generally deficient but local thunderstorms caused considerable variations. The first few days were rather unsettled and cool, rain occurred in many places on the 1st and 2nd and there were local thunderstorms on the 4th. The weather then improved under the influence of an anticyclone over southern England and temperature rose. There was much fog between the 4th and 10th and fog was dense in the Channel on the 5th. Fine and warm weather continued generally, except locally in Scotland and Ireland, until the 11th, when high maximum temperatures were recorded in many parts of England and Wales, including 91°F. at Camden Square, London. The anticyclone was by this time over Germany and cool westerly air from a depression in the mouth of the Channel cutting under the warm southerly current caused thunderstorms in eastern England, southern Scotland and northern Ireland on the night of the 11th to 12th (see p. 186). The weather became unsettled for a few days with shallow depressions crossing the British Isles. By the 15th there was a ridge of high pressure across the British Isles and anticyclonic conditions were re-established. Temperature gradually rose and the 18th and especially the 19th were very hot. The hot spell broke on the 20th-21st and in some places there was a considerable and sudden fall of temperature. Thunderstorms and heavy rain occurred in many places on these two days; several stations recorded more than an inch on the 20th, Henley-on-Thames recorded 2·22 in. and Wellington College, Berks, 2·57 in.; on the 21st Llanthony Lock, Glos., recorded 2·12 in. After a few days of cool, dry weather, temperature rose again about the 26th and during the last few days shallow depressions moving eastwards caused local rain or thunderstorms.

The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	132	— 1	Liverpool	153	—11
Aberdeen	141	— 9	Ross-on-Wye	174	0
Dublin	110	—52	Falmouth	179	—32
Birr Castle	101	—41	Gorleston	166	—40
Valentia	95	—60	Kew	196	+ 9

The special message from Brazil states that rain was scarce in the north and centre and plentiful in the south, the averages being 1·06 in. and 0·16 in. below normal and 1·89 in. above normal respectively. The crops were in good condition. The circulation was active, causing sudden variations in temperature, five anticyclones passed across the country. At Rio de Janeiro the pressure was 0·5mb. and the temperature 0·5° below normal.

Miscellaneous notes on weather abroad culled from various sources.

Severe hailstorms caused much damage in the Bavarian Alps at the beginning of the month and a cloudburst occurred at Garmisch Partenkirchen on the evening of the 13th destroying parts of the railway. A heat wave was experienced along the Riviera between about the 15th and 17th when 108°F. was was reached at Cuers on the 16th and 107°F. at St. Raphael on the 17th. The intense heat extended over the whole of central and southern Europe from the 16th to 21st when 97°F. was reached at Berlin on the 20th and 21st, 95°F. at Paris on the 19th, 97°F. at Madrid on the 17th and 104°F. at Rome on the 17th. (*The Times*, August 3rd-22nd, *Bulletin Quotidien d'Etudes de l'Office National Météorologique de France* and *Daily Weather Report, Meteorological Office, London*).

Eight people were drowned and much damage was done in the neighbourhood of Erzerum (Anatolia) as a result of heavy rain at the beginning of the month. Heavy monsoon rains continued during the early part of the month in the Bombay Presidency but by the 25th the rains had ceased at Bombay though they were still being experienced in the United Provinces and Punjab. A break in the monsoon rains for about a week round about the 20th in Burma caused anxiety (*The Times*, August 4th-26th).

One of the heaviest snowfalls for some time was experienced on the Adelaide Hills, South Australia about the 15th and there were lighter falls in a number of country districts. Further rains in South Australia in the later part of the month have increased the prospects for a record agricultural season there while useful general rains fell in New South Wales and Victoria. Twelve thousand acres of rich dairy land have been flooded in the Wairarapa and Manawatu districts in the North Island of New Zealand. In parts the pastures have been covered with silt to a depth of 18 in. (*The Times*, August 16th-September 2nd.)

Extreme heat and lack of rain prevailed in the southern part of the prairie provinces of the United States early in the month, but elsewhere conditions were favourable for the crops. About the middle of the month conditions became favourable generally but towards the end heavy rains delayed harvesting. Twenty-five people were killed in a hurricane which swept along the Texas coast on the 13th. Temperature was generally above normal in the United States during the first half of the month and the rainfall about normal, although there were some heavy falls in the Mississippi Valley during the second week. (*The Times*, August 4th-31st, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Rainfall, August, 1932—General Distribution

England and Wales	56	per cent of the average 1881-1915.
Scotland	54	
Ireland	62	
British Isles	57	

Rainfall : August, 1932 : England and Wales.

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Lond .	Camden Square	1·57	71	*Leics*	Belvoir Castle............	2·22	85
Sur .	Reigate, Alvington ...	·74	32	*Rut* .	Ridlington	1.52	61
Kent .	Tenterden, Ashenden...	·40	17	*Lincs* .	Boston, Skirbeck	1·72	72
,, .	Folkestone, Boro. San .	·44	...	,,	Cranwell Aerodrome ...	2·01	74
,, .	Margate, Cliftonville...	·68	35	,, .	Skegness, Marine Gdns	2·82	116
,, .	Sevenoaks, Speldhurst	·81	...	,, .	Louth, Westgate	1·99	71
Sus .	Patching Farm	·63	25	,, .	Brigg, Wrawby St. ...	1·47	...
,, .	Brighton, Old Steyne..	·55	25	*Notts* .	Worksop, Hodsock ...	1·38	56
,, .	Heathfield, Barklye ...	·60	22	*Derby* .	Derby, L. M. & S. Rly.	1·84	70
Hants .	Ventnor, Roy. Nat. Hos.	1·01	51	,, .	Buxton, Devon Hos. ...	1·45	33
,, .	Fordingbridge, Oaklnds	1·00	38	*Ches* .	Runcorn, Weston Pt...	1·08	30
,, .	Ovington Rectory	1·72	63	,, .	Nantwich, Dorfold Hall	1·84	...
,, .	Sherborne St. John ...	1·13	47	*Lancs* .	Manchester, Whit Pk.	1·57	45
Berks .	Wellington College ...	3·05	131	,, .	Stonyhurst College ...	1·65	46
,, .	Newbury, Greenham...	·92	35	,, .	Southport, Hesketh Pk	1·62	47
Herts .	Welwyn Garden City...	2·33	...	,, .	Lancaster, Strathspey	1·83	...
Bucks .	H. Wycombe, Flackwell	...	...	*Yorks* .	Wath-upon-Dearne ...	1·92	80
Oxf .	Oxford, Mag. College...	2·06	92	,, .	Bradford, Lister Pk. ...	·96	35
Nor .	Pitsford, Sedgebrook...	2·01	83	,, .	Oughtershaw Hall	1·72	...
,, .	Oundle.....................	1·67	...	,, .	Wetherby, Ribston H.	1·86	68
Beds .	Woburn, Crawley Mill	4·31	186	,, .	Hull, Pearson Park ...	1·61	55
Cam .	Cambridge, Bot. Gdns.	2·35	100	,, .	Holme-on-Spalding ...	1·16	...
Essex .	Chelmsford, County Lab	1·09	50	,, .	West Witton, Ivy Ho.	1·19	41
,, .	Lexden Hill House ...	·80	...	,, .	Felixkirk, Mt. St. John	1·74	61
Suff .	Haughley House.........	2·81	...	,, .	Pickering, Hungate ...	2·04	79
,, .	Campsea Ashe...........	1·28	65	,, .	Scarborough	1·54	55
Norf .	Norwich, Eaton.........	...	...	,, .	Middlesbrough	2·41	88
,, .	Wells, Holkham Hall	2·44	102	,, .	Balderdale, Hury Res.	1·50	...
,, .	Swaffham, The Villa...	1·23	47	*Durh* .	Ushaw College	2·60	89
Wilts .	Devizes, Highclere......	1.21	42	*Nor* .	Newcastle, Town Moor	2·17	74
,, .	Bishops Cannings	1·01	33	,, .	Bellingham, Highgreen	1·54	44
Dor .	Evershot, Melbury Ho.	·66	21	,, .	Lilburn Tower Gdns...	1·19	42
,, .	Creech Grange	1·09	38	*Cumb* .	Geltsdale.................	2·00	...
,, .	Shaftesbury, Abbey Ho.	·69	24	,, .	Carlisle, Scaleby Hall	2·17	53
Devon .	Plymouth, The Hoe...	1·86	60	,, .	Borrowdale, Seathwaite	...	...
,, .	Launceston, Werringt'n	2·33	...	,, .	Borrowdale, Moraine...	1·88	...
,, .	Holne, Church Pk. Cott.	2·08	47	,, .	Keswick, High Hill...	1·21	...
,, .	Cullompton..............	1·92	63	*West* .	Appleby, Castle Bank	1·00	30
,, .	Sidmouth, Sidmount...	1·61	57	*Glam* .	Cardiff, Ely P. Stn. ...	1·16	27
,, .	Filleigh, Castle Hill ...	2·10	...	,, .	Treherbert, Tynywaun	1·45	...
,, .	Barnstaple, N. Dev. Ath	1·21	37	*Carm* .	Carmarthen Friary ...	·60	13
,, .	Dartm'r, Cranmere Pool	2·10	...	*Pemb* .	Haverfordwest, School	2·30	55
Corn .	Redruth, Trewirgie ...	1·65	48	*Card* .	Aberystwyth	1·16	...
,, .	Penzance, Morrab Gdn.	1·69	53	,, .	Cardigan, County Sch.	1·33	...
,, .	St. Austell, Trevarna...	1·24	34	*Brec* .	Crickhowell, Talymaes	3·30	...
Soms .	Chewton Mendip	1·09	24	*Rad* .	Birm W.W. Tyrmynydd	1·33	25
,, .	Long Ashton	1·21	34	*Mont* .	Lake Vyrnwy...........	1·68	32
,, .	Street, Millfield.........	1·20	44	*Denb* .	Llangynhafal	1·72	58
Glos .	Blockley	5·58	...	*Mer* .	Dolgelly, Bryntirion...	1·74	34
,, .	Cirencester, Gwynfa ...	1·39	46	*Carn* .	Llandudno	1·85	61
Here .	Ross, Birchlea...........	1·97	77	,, .	Snowdon, L. Llydaw 9	3·90	...
,, .	Ledbury, Underdown..	2·70	103	*Ang* .	Holyhead, Salt Island	1·52	48
Salop .	Church Stretton.........	1·36	42	,, .	Lligwy....................	1·14	...
,, .	Shifnal, Hatton Grange	2·46	88	*Isle of Man*			
Worc .	Ombersley, Holt Lock	3·21	119		Douglas, Boro'. Cem. ...	4·89	126
War .	Birminghm, Edgbaston	2·48	91	*Guernsey*			
Leics .	Thornton Reservoir ...	1·31	47		St. PeterP't. Grange Rd	·41	17

Erratum for July. Skegness, M

Rainfall: August, 1932: Scotland and Ireland.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt .	Pt. William, Monreith	2·08	54	*Suth* .	Melvich	2·72	...
,, .	New Luce School	2·74	61	,, .	Loch More, Achfary	6·06	104
Kirk .	Carsphairn, Shiel	2·51	37	*Caith* .	Wick	2·72	99
Dumf .	Dumfries, Crichton, R. I	1·86	...	*Ork* .	Pomona, Deerness	2·97	103
,, .	Eskdalemuir Obs.	2·11	41	*Shet* .	Lerwick	3·71	123
Roxb .	Branxholm	1·68	52	*Cork* .	Caheragh Rectory	1·84	...
Selk .	Ettrick Manse	2·00	38	,, .	Dunmanway Rectory	2·65	56
Peeb .	West Linton	1·17	...	,, .	Ballinacurra	2·30	62
Berw .	Marchmont House	·75	23	,, .	Glanmire, Lota Lo.	2·53	69
E. Lot .	North Berwick Res.	·21	7	*Kerry* .	Valentia Obsy	2·96	62
Midl .	Edinburgh, Roy. Obs.	·37	12	,, .	Gearahameen	2·90	...
Lan .	Auchtyfardle	1·09	...	,, .	Killarney Asylum	2·62	59
Ayr .	Kilmarnock, Kay Pk.	2·17	...	,, .	Darrynane Abbey	2·39	55
,, .	Girvan, Pinmore	1·84	41	*Wat* .	Waterford, Gortmore	2·13	56
Renf .	Glasgow, Queen's Pk.	1·26	36	*Tip* .	Nenagh, Cas. Lough	3·83	97
,, .	Greenock, Prospect H.	3·26	60	,, .	Roscrea, Timoney Park	3·24	...
Bute .	Rothesay, Ardencraig.	1·46	30	,, .	Cashel, Ballinamona	2·33	66
,, .	Dougarie Lodge	2·45	...	*Lim* .	Foynes, Coolnanes	2·50	65
Arg .	Ardgour House	7·36	...	,, .	Castleconnel Rec.	3·72	...
,, .	Glen Etive	...	...	*Clare* .	Inagh, Mount Callan	2·99	...
,, .	Oban	3·29	71	,, .	Broadford, Hurdlest'n.	2·91	...
,, .	Poltalloch	3·99	81	*Wexf* .	Gorey, Courtown Ho.	2·51	75
,, .	Inveraray Castle	4·44	67	*Kilk* .	Kilkenny Castle	2·00	57
,, .	Islay, Eallabus	3·37	77	*Wick* .	Rathnew, Clonmannon	2·43	...
,, .	Mull, Benmore	...	...	*Carl* .	Hacketstown Rectory	2·48	61
,, .	Tiree	3·48	...	*Leix* .	Blandsfort House	3·27	83
Kinr .	Loch Leven Sluice	·42	11	,, .	Mountmellick	3·50	...
Perth .	Loch Dhu	2·55	38	*Offaly* .	Birr Castle	1·46	38
,, .	Balquhidder, Stronvar	3·22	...	*Kild'r.*	Monasterevin	...	...
,, .	Crieff, Strathearn Hyd.	1·64	39	*Dublin*	Dublin, FitzWm. Sq.	1·47	48
,, .	Blair Castle Gardens	1·82	54	,, .	Balbriggan, Ardgillan.	2·69	79
Angus.	Kettins School	·85	26	*Meath.*	Beauparc, St. Cloud	2·16	...
,, .	Dundee, E. Necropolis	·87	26	,, .	Kells, Headfort	1·39	33
,, .	Pearsie House	1·31	...	*W. M* .	Moate, Coolatore	1·06	...
,, .	Montrose, Sunnyside	·69	25	,, .	Mullingar, Belvedere	1·99	48
Aber .	Braemar, Bank	·82	24	*Long* .	Castle Forbes Gdns.	2·97	73
,, .	Logie Coldstone Sch.	·99	31	*Gal* .	Ballynahinch Castle	4·55	83
,, .	Aberdeen, King's Coll.	2·10	77	,, .	Galway, Grammar Sch.	...	...
,, .	Fyvie Castle	1·03	32	*Mayo* .	Mallaranny	3·48	...
Moray	Gordon Castle	1·52	48	,, .	Westport House	1·40	35
,, .	Grantown-on-Spey	...	...	,, .	Delphi Lodge	3·58	42
Nairn.	Nairn	2·01	42	*Sligo* .	Markree Obsy	2·55	59
Inv's	Ben Alder Lodge	2·46	...	*Cavan.*	Belturbet, Cloverhill	2·45	66
,, .	Kingussie, The Birches	1·67	...	*Ferm* .	Enniskillen, Portora	...	...
,, .	Loch Quoich, Loan	5·75	...	*Arm* .	Armagh Obsy	2·41	67
,, .	Glenquoich	6·86	84	*Down* .	Fofanny Reservoir	4·89	...
,, .	Inverness, Culduthel R.	1·09	...	,, .	Seaforde	4·57	122
,, .	Arisaig, Faire-na-Squir	3·95	...	,, .	Donaghadee, C. Stn.	2·53	76
,, .	Fort William, Glasdrum	4·32	...	,, .	Banbridge, Milltown	2·19	...
,, .	Skye, Dunvegan	4·71	...	*Antr* .	Belfast, Cavehill Rd.	2·63	...
,, .	Barra, Skallary	3·78	...	,, .	Glenarm Castle	2·13	...
R & C .	Alness, Ardross Castle	1·43	48	,, .	Ballymena, Harryville	2·17	51
,, .	Ullapool	3·54	100	*Lon* .	Londonderry, Creggan	2·46	53
,, .	Achnashellach	6·02	...	*Tyr* .	Omagh, Edenfel	2·19	51
,, .	Stornoway	4·57	...	*Don* .	Malin Head	1·64	...
Suth .	Lairg	2·32	73	,, .	Dunfanaghy	1·23	...
,, .	Tongue	3·24	101	,, .	Killybegs, Rockmount.	1·50	27

Climatological Table for the British Empire, March, 1932

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Per-cent-age of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1015·0	+ 1·6	55	24	48·2	33·8	41·0	— 1·4	34·7	87	5·0	1·29	— 0·40	10	3·9	33
Gibraltar	1014·2	— 2·8	75	46	67·2	51·2	59·2	+ 1·7	50·9	82	5·8	4·76	— 0·03	13	..	..
Malta	1013·3	— 0·9	74	43	60·6	52·0	56·3	— 0·8	52·3	79	6·6	1·88	+ 0·40	13	6·0	51
St. Helena	1012·8	+ 0·4	72	59	68·1	61·2	64·7	— 1·6	61·9	94	8·7	6·69	..	24	..	..
Sierra Leone	1012·5	+ 1·8	91	72	87·8	75·3	81·5	— 0·9	76·1	78	4·7	1·29	+ 0·13	5	..	..
Lagos, Nigeria	1009·6	+ 0·7	91	71	87·4	77·0	82·2	— 1·2	77·5	80	8·1	2·61	— 1·14	11	5·5	46
Kaduna, Nigeria	1009·4	— 2·5	100	58	95·6	70·2	82·9	+ 1·8	69·9	54	5·7	1·98	+ 1·44	1	7·5	63
Zomba, Nyasaland	1009·1	— 0·6	84	61	79·4	65·0	72·2	+ 0·9	..	80	7·3	6·87	— 2·21	13	..	..
Salisbury, Rhodesia	1012·5	— 0·4	82	50	78·3	58·0	68·1	— 0·1	61·6	76	6·5	3·10	— 1·60	13	6·1	50
Cape Town	1015·4	+ 0·9	92	53	78·4	59·6	69·0	+ 0·9	60·4	78	3·6	0·74	— 0·14	8	..	..
Johannesburg	1012·8	— 0·1	81	45	74·1	54·1	64·1	+ 0·7	56·7	74	4·7	3·53	— 0·91	11	7·7	63
Mauritius	1010·9	— 1·1	88	70	84·7	73·4	79·1	+ 1·1	76·6	80	6·3	10·92	+ 1·55	24	7·4	61
Calcutta, Alipore Obsy.	1010·4	+ 0·5	100	63	94·5	71·4	82·9	+ 2·7	71·1	78	2·3	0·69	— 0·69	1*	..	..
Bombay	1010·8	— 0·1	96	70	88·5	73·5	81·0	+ 1·5	72·1	75	1·0	0·00	— 0·02	0*	..	..
Madras	1011·3	+ 0·4	94	66	88·6	70·7	79·7	— 1·4	73·7	76	3·1	0·00	— 0·34	0*	..	..
Colombo, Ceylon	1010·7	+ 0·6	92	69	88·2	73·7	80·9	— 0·9	76·1	74	5·3	2·60	— 1·68	11	7·8	64
Singapore	1009·8	+ 0·1	92	71	87·1	73·0	80·1	— 1·1	76·1	77	6·6	7·18	— 0·22	12	6·2	51
Hongkong	1017·3	+ 1·3	81	47	67·9	58·8	63·3	0·0	58·2	73	6·7	2·20	— 0·74	12	4·2	35
Sandakan	..	..	89	71	86·9	73·8	80·3	— 0·7	76·7	83	..	18·66	+ 10·19	15	..	..
Sydney, N.S.W.	1015·2	— 1·1	88	51	76·3	64·0	70·1	+ 0·8	64·8	70	6·4	3·11	— 1·87	10	7·0	57
Melbourne	1014·9	— 2·0	95	48	73·1	54·5	63·8	— 0·7	57·9	71	7·0	4·24	+ 2·06	16	5·1	41
Adelaide	1015·9	— 1·2	97	47	80·5	58·8	69·7	— 0·1	58·0	41	5·6	1·49	+ 0·46	9	7·4	61
Perth, W. Australia	1017·0	+ 1·7	97	50	79·6	60·7	70·1	— 1·1	59·1	53	3·9	0·17	— 0·64	2	8·8	72
Coolgardie	1014·9	+ 0·1	108	50	87·3	58·1	72·7	+ 0·8	58·1	47	3·1	0·55	— 0·39	2	..	..
Brisbane	1015·8	+ 1·4	89	63	84·2	67·8	76·0	+ 1·7	69·0	64	5·6	1·46	— 4·32	8	8·9	72
Hobart, Tasmania	1013·6	— 0·6	83	44	67·4	52·0	59·7	+ 0·4	53·9	68	6·4	6·46	+ 4·76	13	5·8	47
Wellington, N.Z.	1022·9	+ 5·7	73	44	65·0	52·3	58·7	— 1·9	55·4	76	6·9	0·35	— 2·98	5	6·2	50
Suva, Fiji	1009·6	+ 1·2	90	71	86·2	74·6	80·4	+ 0·3	75·8	80	6·3	11·03	— 3·46	25	6·5	53
Apia, Samoa	1008·6	— 0·6	88	73	86·0	74·5	80·3	+ 1·0	77·1	77	5·2	14·20	+ 0·22	21	6·8	56
Kingston, Jamaica	1013·4	— 1·5	91	65	85·8	70·0	77·9	+ 0·8	67·8	79	3·8	0·22	— 0·80	1	9·1	76
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1011·1	— 6·2	58	5	34·8	23·5	29·1	— 0·5	24·4	68	6·2	0·15	— 2·26	3	3·9	33
Winnipeg	1019·7	+ 0·5	38	—20	17·8	0·8	9·3	— 5·7	..	..	3·7	0·00	— 1·16	0	6·1	51
St. John, N.B.	1002·4	—11·7	48	5	33·9	21·0	27·5	— 0·9	22·1	69	5·8	2·39	— 2·15	9	4·8	40
Victoria, B.C.	1016·8	+ 0·9	59	31	49·2	40·8	45·0	+ 1·5	41·9	87	8·4	3·86	+ 1·43	22	3·7	31

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

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The Frequency Curve of Daily Rainfall

In a paper on "30 Years' Rainfall at the West of Scotland Agricultural College, Kilmarnock" in *British Rainfall*, 1931, Mr. W. Dunbar gives data from which I have computed the values of rainfall probability shown in the lines marked (*a*) in the following table:—

PROBABILITY OF DAILY RAINFALL WITH SPECIFIED LOWER LIMIT.
(*Kilmarnock*, *averages* 1901-1930.)

			0.01 in.	0.04 in.	0.10 in.	0.20 in.	0.30 in.	0.40 in.	0.50 in.	0.60 in.	0.80 in.
Jan.	Obs.	(*a*)	0.69	0.56	0.42	0.26	0.17	0.10	0.07	0.04	0.01
	Calc.	(*b*)	0.64	0.56	0.42	0.26	0.17	0.10	0.07	0.04	0.01
July	Obs.	(*a*)	0.54	0.40	0.28	0.17	0.11	0.07	0.05	0.03	0.02
	Calc.	(*b*)	0.44	0.39	0.29	0.18	0.11	0.07	0.05	0.03	0.01
Year	Obs.	(*a*)	0.58	0.46	0.33	0.20	0.13	0.08	0.05	0.03	0.01
	Calc.	(*b*)	0.54	0.46	0.34	0.21	0.13	0.08	0.05	0.03	0.01

The entry in each case represents the random probability of registering an amount of rainfall, in 24 hours, equalling or exceeding the value given at the top of the column. Thus in July the observed probability of a daily rainfall of 0.10 inch or more is 0.28, this figure having been derived from the fact that during the 30 years of observation, 28 per cent. of all days in July gave a reading of 0.10 inch or more.

A curve formed by plotting the probability (or the percentage

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frequency) as ordinate against the limiting value of the rainfall as abscissa gives a great deal of useful information. In particular the " median," " upper quartile " and " upper decile " values of the rainfall are ascertained at once by reading off the abscissæ corresponding with the percentage values 50, 25 and 10 respectively. When the curve for Kilmarnock for the whole year was drawn it seemed to bear a strong resemblance to a logarithmic curve and the values were accordingly replotted on semi-logarithmic paper. It was then seen that for values of rainfall 0.04 inch and upwards the plotted points lay almost exactly on a straight line, indicating that the percentage frequency F and limiting rainfall r were related by an equation of the form, log F = a − br. The graph is reproduced (fig. 1). A similar result was obtained with the values in individual months. In the above table the values marked (*b*) are those read off from straight lines giving the best fit, as estimated by

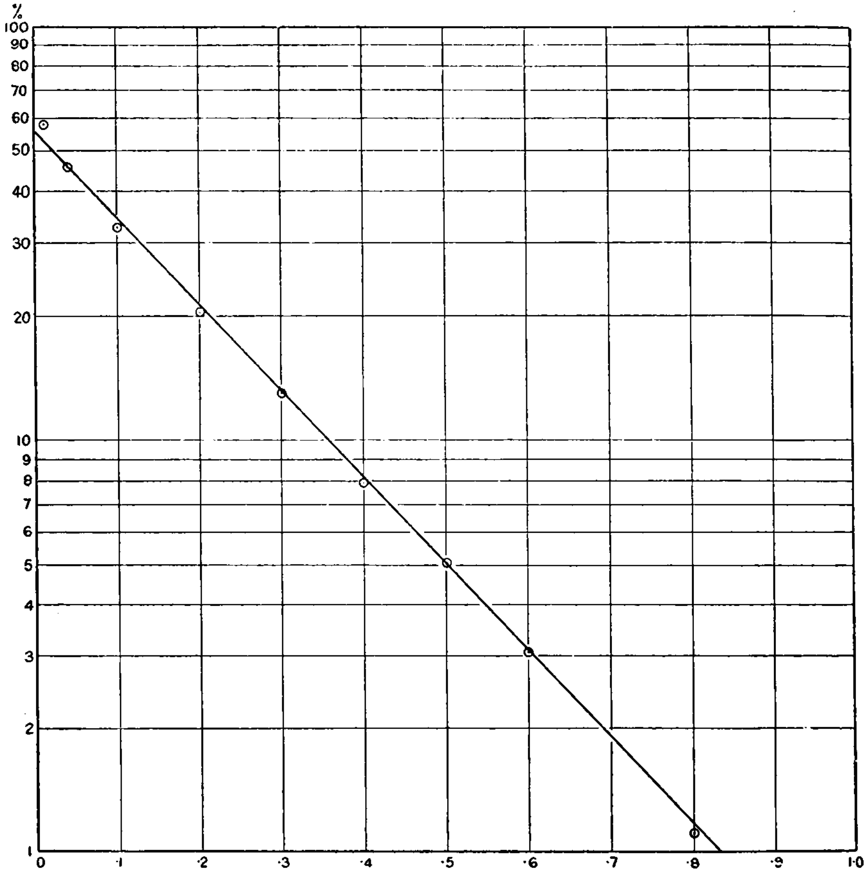

FIG. 1.—INTEGRATED PERCENTAGE FREQUENCIES OF DAILY RAINFALL AT KILMARNOCK (WHOLE YEAR); MEAN FOR 30 YEARS 1901-30.

eye, with the points plotted on semi-logarithmic paper. The agreement with the observed values is very close indeed and we are justified in concluding that at Kilmarnock the integrated frequency curve of daily rainfall is of logarithmic form for rainfall values of 0.04 inch or more.

It seems unlikely that this phenomenon is confined to Kilmarnock and it is hoped in due course to publish the results of examining the data for a number of stations.

E. G. BILHAM.

The Rainfall of Malta with a remark on long-period forecasting

In the course of an investigation on the climate of the Maltese Islands the rainfall has received attention from a rather unusual angle with results of some general interest.

The information given by a crude statement of the number of rain-days at a station, while providing some idea of the character of the climate, is by no means complete and may be misleading. In the first place the definition of a rain-day as a day with, say, 0.2 mm. or more of rain eliminates a possibly large number of days when rain falls; and the total number of days with rain, however small the amount, may have more climatological significance than the number of official rain-days. Moreover, while the total amount yielded on the days with less than the defining amount is certainly negligible when considered as a contribution to the total annual rainfall, it is by no means equally evident that falls of 0.2 mm. are necessarily significant.

TABLE I.

Daily fall in mm.	less than 0.2	0,2–1.0	1.1–5.0	5.1–10.0	10.1–20.0	20.1–40,0	Over 40.0
Percentage of total fall	Negligible	3	14	18	28	23	14
Percentage of number of days with rain	25	23	26	12	9	4	1
Percentage of number of rain-days	—	30	35	16	12	5	2

To give anything like a complete statement it is necessary to consider the relative frequency of daily falls of different amounts, and with this object in view the rainfall for the ten years 1922-32 has been analysed according to the daily amount of rain, using the intervals bounded by the value 0.0, 0.2, 1.0, 5.0, 10.0, 20.0 and 40.0 mm. In Table I percentages are given showing the proportions of the total rainfall, the number of rain-days and the number of days with rain, however small the amount, due to daily falls within the different ranges, while in fig. 1 the same information is given diagrammatically in the form of sum-curves, which are much better adapted to the representation of such distributions than are curves of frequency. Thus the ordinates of the three curves in fig. 1 are defined as follows:—

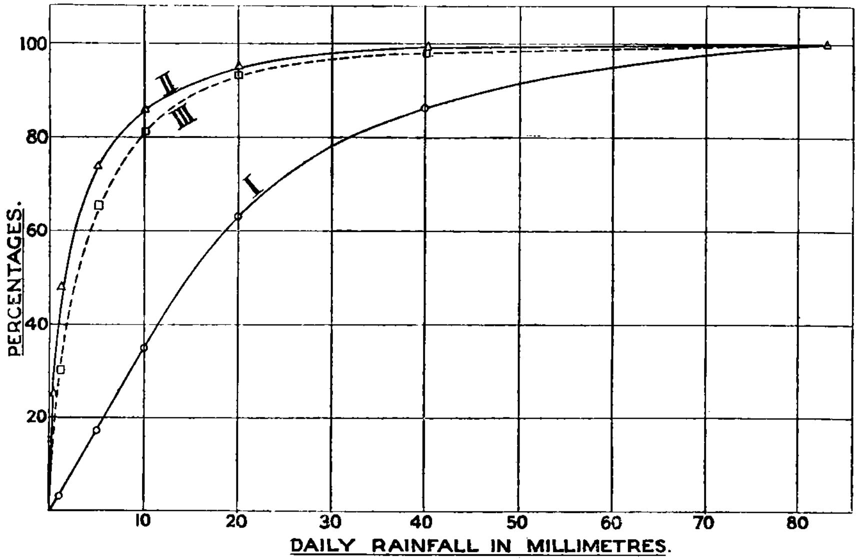

Fig. 1.

Curve I.—The ordinate gives the percentage of the total rainfall due to daily falls of amount less than that defined by the abscissa.

Curve II.—The ordinate gives the number of days with rain of amount less than that defined by the abscissa, as a percentage of the total number of days with rain.

Curve III.—As in II, but considering only "rain-days," that is, ignoring falls of less than 0.2 mm.

It is possible from these curves to determine the importance of various daily amounts as contributions to the total rainfall, the number of days with rain or the number of rain-days, as, for example, that falls of 1 mm. or below while accounting for 30 per cent. of rain-days and 48 per cent. of days with rain give only 3 per cent. of the total rainfall. For all practical purposes such an amount of rain is of no significance, so that there would be a case for putting the definition of a "rain-day" at something like 1 mm. rather than 0.2 mm. At the other end of the scale it is observed that falls over 20 mm. give 37 per cent. of the rain on only 7 per cent. of rain-days, while falls over 40 mm. account for only 2 per cent. of rain-days while yielding, in the mean, 14 per cent. of the amount. It is clear, therefore, that while the frequency of heavy falls decreases as the amount increases the decrease is not sufficiently rapid to compensate for the heaviness of the fall until very large values are reached. The division at 10 mm. is of particular interest, for above that daily amount we have 65 per cent. of the rain with only 19 per cent. of the days, that is the bulk of the rain on a small proportion of the days. It may therefore be inferred that the rainfall in any individual year is determined largely by the daily falls of 10 mm. or over, a fact which is very clearly brought out by fig. 2, where, for each of the ten years 1922-32, the annual amounts due to falls above and below 10 mm. per day have been determined and plotted as ordinates with the total rainfall as abscissæ. It will be observed that the triangles marking the amounts due to the lighter falls are distributed round a line of small slope showing that these falls contribute a more or less constant amount to the total rainfall. The circles, on the other hand, giving the amounts due to daily falls over 10 mm., define a line of much larger slope proving that the total rainfall is mainly determined by these falls. The indication of figs. 1 and 2 is quite definite, and it is given as a fact of considerable importance that the total rainfall at Valletta is largely determined by the amounts yielded on the few days (on the average about 15 per year) with over 10 mm.

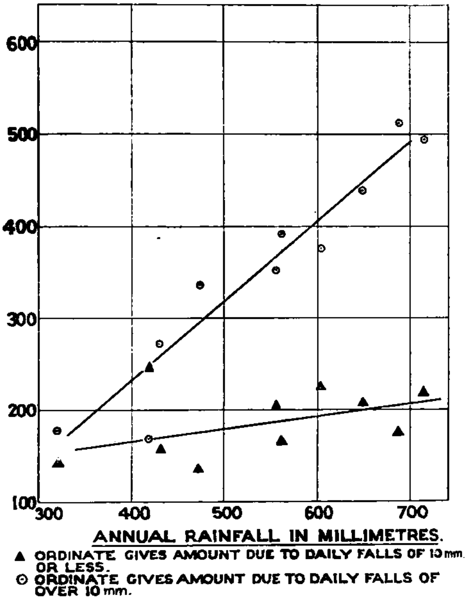

Fig. 2.

This result is of great significance when dealing with the rainfall of Malta from the point of view of seasonal forecasting, for a year of large rainfall need not be one of really abnormal raininess in any general sense but merely one with a few more occurrences of heavy rain than the average, so that we are dealing in statistics with the rainfall due to a small number of occasions, which is most unsatisfactory material for statistical treatment, while in seasonal forecasting we are attempting to estimate the yield of a few heavy falls, a very different problem from anticipating the general tendency of a season.

Now, the ocurrence of rain depends upon the association of suitable values of many factors so inter-related that a small change in one of them may imply profound changes in future developments, as is evident, for example, in cases of vertical instability, where a small difference in temperature or humidity at some level may entirely alter the course of events over a very wide field. There is a more than superficial analogy between meteorological events in general and the small-scale phenomena of turbulence or the yet smaller of molecular motion, and detailed forecasting will probably never be feasible beyond a certain time determined by the stability and inertia of "present conditions." While long-period forecasting does not aim at giving more than a general indication of the character of a season, it is very important to establish that the values of the quantity to be forecast are not mainly determined by occasional large fluctuations, before its treatment by correlation, periodicities or other statistical method can be justified. For if particular outstanding values are important, the forecasting of mean values involves the same problems as detailed forecasting and has therefore the same limitations.

The nature of meteorology is such that the frequency distributions of the values of many factors is far from "normal," and probably in many cases exceptional values are most important. For example, in many regions the greater part of the annual rainfall is probably due, as in Malta, to a few disturbances giving comparatively large amounts, while mean anomalies of pressure may frequently be largely determined by the few occasions of large anomaly. Every particular case should be examined critically, but without further investigation strong support must be given to the point of view held by many meteorologists that seasonal forecasting is, in some cases (of which the rainfall of Malta is one definite example), not only difficult but quite impracticable.

R. C. SUTCLIFFE.

Meteorological Records from the northern Pennines

The high fell country of the north Pennines, comprising the country between upper Teesdale, the valley of the South Tyne, Weardale, and the valley of the Eden on the west, is notable as it provides the most considerable extent of upland above 1,500 feet in England. This bleak and elevated tract, however, is by no means devoid of population; the highest villages in England, the highest main roads, and what the writer believes to be the highest inhabited house, are all to be found in the Crossfell region. In the past, records of temperature have been kept at Alston (1,145 feet) and Allenheads (1,360 feet), and they are quoted in Bartholomew's Atlas of England and Wales.

Rain-gauges, rather on the fringe of the area, are kept at Alston, in Lunedale and Baldersdale to the south, and at Newbiggin in Teesdale. Several high-level gauges are also to be found on the east, around the head of Weardale, in connexion with the new reservoir of the Durham County Water Board. Of these, the highest is at 1,950 feet. On the higher ground nearer Crossfell, however, no meteorological records have been kept until this year, as far as the writer is aware.

With a view to futher investigation of the climate of these uplands, the writer has established a thermograph in a Stevenson screen at Moor House, a keeper's cottage in extreme upper Teesdale, the Council of the Durham Colleges having made a small grant to defray expenses. The keeper, Mr. Armstrong, has most kindly undertaken the weekly changing of the charts, and records have been kept since January 23rd. The height of the station above sea level is 1,840 feet, considerably higher than any other station hitherto in operation in Great Britain, with the exception of Ben Nevis. Moor House is also the more interesting in that it lies in the midst of completely uncultivated moorland, excepting the small hayfield in front of the house: the nearest inhabited house is about four miles distant. The thermograph screen is in a small enclosure near the house, which stands on ground sloping north-west to a valley. The stream is about 60 feet below the level of the house and 200 yards from it.

The records so far show several features of interest, although it is too early to embark on an extensive discussion as yet. Further, the winter has been much more open than usual, in contrast to the experience of 1931, when the track leading to the house was blocked by snow for over two months. This year snow lay on north slopes for about five weeks in all, but never attained any great depth. The abundant February sunshine cleared the south slopes rapidly after the falls of the second week, and the falls in March, April and May were never large.

Temperatures, compared with those of Durham (336 feet), show, over six months, an average difference almost exactly what might be expected, 5.4°F. for 1,500 feet. The daily range; however, is less at Moor House, except during the month of June, which, as usual towards the north-east coast, was marked at Durham by a good many days of " sea-fret " and cloudy weather. Maxima have averged 6.5° below those of Durham, minima 4.3°. It may further be pointed out that the Durham station is on a ridge and that considerably lower minima often occur at the valley station of Houghall, two miles distant. The small range at Moor House, however, may largely be attributed to the frequent mists which cover the Crossfell plateau, and the strong winds. On those rare nights which are both clear and calm, temperatures may fall very low, e.g., a minimum of 20° on May 8th. The coldest night so far recorded was that of March 11th–12th, minimum 11.5°. Frequently on winter nights the minimum occurs before midnight, after which the trace shows sharp fluctuations; the writer is inclined to suggest that these may be due to disturbance of the air in the shallow valley by slight gusts, but so far there has not been much opportunity for forming an opinion.

The following figures may be quoted for the station; however, the records for several days in May and early June are imperfect owing to the pen-arm sticking after a long period of damp, misty weather, so that the results for the month (marked with an asterisk in the table) are only to be regarded as approximate.

	Mean	Mean Maximum	Mean Minimum	Extremes for Month and Dates			
				Max.		Min.	
February	32·8	37·4	28·2	47	3rd	18·5	17th
March	33·8	38·4	29·1	48	23rd	11·5	12th
April	35·5	40·6	30·4	50·5	29th	21·5	3rd
May	42·4*	46·9*	37·8	56	31st	20	8th
June	49·5*	57·6*	41·5	69·5	17th	33	16th
July	53·2	58·8	47·6	70	10th	41	18th
August	53·9	60·4	47·5	77	11th	31	24th

Gordon Manley.

OFFICIAL NOTICE

Discussions at the Meteorological Office

The series of meetings for the discussion of recent contributions to meteorological literature, especially in foreign and colonial journals, will be resumed at the Meteorological Office, South Kensington, during the session 1932-3. The meetings will be held on alternate Mondays at 5 p.m., beginning on Monday, October 17th, 1932, when Dr. G. C. Simpson, C.B., F.R.S., will open the discussion of a paper entitled "The structure of wind over level country. Report on experiments carried out at the Royal Airship Works, Cardington," by the late M A. Giblett, M.Sc., and other members of the staff of the Meteorological Office (*London, Meteor. Office, Geophys. Mem., No.* 54).

The dates for subsequent meetings are as follows:—

October 31st, November 14th and 28th, December 12th, 1932; January 16th and 30th, February 13th and 27th and March 13th, 1933.

The subjects for discussion for the next two meetings are:—

October 31st, 1932, *Terrestrial-magnetic activity and its relation to solar phenomena.* By J. Bartels (Terr. Mag., Washington, D.C., 37, 1932, pp. 1-52). *Opener*—Mr. R. A. Watson, B.A.

November 14th, 1932. *The problem of the dissipation of fog.*

By A. Baldit (Météorologie, Paris, 7, 1931, pp. 383-97) (in French). *Opener*—Mr. C. H. Kellett, B.Sc.

The Director of the Meteorological Office wishes it to be known that visitors are welcomed at these meetings.

OFFICIAL PUBLICATION

The following publication has recently been issued:—

Annual Report *of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the year ending March* 31, 1932.

In its main lines the work of the Meteorological Office during the year under review has continued as in previous years, but the demands made on the Office have continued to grow and every department reports an increase in the number of inquiries received and the amount of information supplied. The year is noteworthy for the completion of three undertakings, the complete reorganization of the arrangements made at Headquarters in London for the preparation of weather forecasts, the successful conclusion of a scheme for simplifying the exchange of meteorological information between the countries of the northern hemisphere, and the completion of a series of tours made by the Superintendent of the Navy Services to the chief naval stations of the world, in order to organize the supply of meteorological information to the Royal Navy when on foreign service.

Before the reorganization of the forecasting arrangements, the supply of forecasts for aviation and for other purposes was the work of two separate divisions, but there was no essential difference between the two types of forecast and they have now both been placed in charge of the Forecasting Division, thus avoiding a certain amount of duplication. Forecasting work has also been facilitated by the simplification of the exchange of weather information between different countries, which required close international co-operation. After some initial difficulties, the new system is now working smoothly and regularly.

The Aviation Service has provided special assistance for a number of long-distance flights, including two to Australia, two to Africa and one to Japan, and also, in connexion with several projected trans-Atlantic flights, for the cruise of the airship *Graf Zeppelin*, and for the first successful flight by a glider across the English Channel. A beginning has been made, in co-operation with the Automobile Association, with a special service for the supply of meteorological information to owner pilots.

During 1932-3 will be held the Second International Polar Year, during which a number of countries will send expeditions to high latitudes to obtain data for studies in meteorology and terrestrial magnetism. The Meteorological Office has organized a British expedition to Fort Rae in Canada, under the leadership of Mr. J. M. Stagg, who visited the site during 1931 to make preliminary arrangements. At the end of the year preparations were well advanced for the departure of the party in May, 1932.

Correspondence

To the Editor, *The Meteorological Magazine.*

Summer Weather in Ungava Bay

In the *Meteorological Magazine* for August, 1932, there is an article by Mr. S. T. A. Mirrlees under the above heading, from which it would appear that there are practically no meteorological records for the Hudson Straits region. This is far from being the case, as the Meteorological Service of Canada has stations at the following places:—

Station	No. of Years' Observations	Lat. N. °	Lat. N. ′	Long. W. °	Long. W. ′
Lake Harbour (Ashe's Inlet) ...	24	62	50	70	40
Pond Inlet	7	72	43	77	45
Fort Chimo	8	58	10	68	10
Port Harrison	8	58	25	78	21
*Hope's Advance	5	61	5	69	33
*Nottingham Island	6	63	7	77	56
*Resolution Island	3	61	18	64	53
Pangnirtung	4	66	9	65	30
*Chesterfield Inlet	10	63	45	91	50
*Churchill	46	58	51	94	11

* There are wireless stations at these places also.

At five of the places there are wireless stations and weather reports are received from them twice a day. A record of the observations is published in our *Monthly Record of Meteorological Observations*, and some of them are summarised in an article in the *Canada Year Book* for 1930.

J. PATTERSON, *Director.*

Department of Marine, Meteorological Service of Canada, Toronto 5, *Ontario.*
September 17*th*, 1932.

The Thunderstorm of August 12th, 1932

The times given in the September number of the *Meteorological Magazine* show that the storm at Rickmansworth broke out only about ten minutes later than its arrival over South Farnborough, although the former place is 27 miles off in a direction N.26°E. My remark in the same number, to the effect that the storm travelled in a south-south-west upper current of the order of 30 m.p.h., was based on the pilot balloon observations in south-east England between 5,000 and 9,000 feet, the highest level observed. The Duxford aeroplane pilot gave 5,200 feet as the height of the cloud base. It is evident that the short time interval noted above was due to a development rather than to a drift. The relatively long duration of the Rickmansworth storm indicates some elongation along the upper current. The cold front was oriented about north to south and was moving at an average speed of about 17 m.p.h., so that one would have expected it to pass Rickmansworth fully 40 minutes later than South Farnborough. There was no close relation between the front and the storm, which occurred an hour after the front over the London area, including Croydon. An elongation along the upper current is fairly common, and is not always simply related to a front. Attention may be called to the thunderstorm of July 20th, 1929,* when a pronounced line-squall moved in an unusual direction from south to north, whereas the heavy rain splashes were on a belt from roughly south-west to north-east, and the London storm was on the whole elongated in that direction. When a cold front is less sharply defined it is complicated by local squalls caused by heavy rainfall, and it is sometimes impossible to unravel the puzzle.

There is a need for further investigation into the structure of thunderstorms, based on synchronous maps at short intervals. Perhaps the variation of wind with height is important. If the elongation is parallel to the shear, it would be along the upper current in the fairly numerous cases when the wind increases with height without changing direction. Sometimes the elongation is across the upper current. The London storm on the night of August 20th, 1932, was an example of this, and in consequence the heavy rain only lasted for about ten minutes. The heavy rain reached Croydon at about 23h. 10m., and Kingsway between 23h. 30m. and 23h. 35m. G.M.T., the speed showing reasonable agreement with what one would have expected from the upper current. (At 8,000 feet at South Farnborough at 18h. 20m. the wind was SSW., 31 m.p.h.; at Lympne at 17h. 20m., SSW., 34 m.p.h.; Kingsway is 11½ miles due north of Croydon aerodrome.)

C. K. M. DOUGLAS.

September 26th, 1932.

Thunderstorm Phenomena

While at Grayshott during August, I observed thunderstorms on the 12th and 20th, both of which were remarkable for the

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*See *Meteorological Magazine*, 64, 1929, p. 156 and p. 187.

exceptional frequency of the lightning and thunder. On the 12th thunder was first heard at 0h. 20m. G.M.T., and the discharges were so numerous that it was not until 1h. 40m. that I could with certainty associate a given flash with its appropriate clap in order to find the distance. From 1h. 36m. to 1h. 46m. the thunder roll never ceased; it was followed by 1 second of quiet, and then there was another period of incessant rumble for exactly 6 minutes 40 seconds.

Again, on August 20th from 22h. 59m. to 23h. 14m. I timed a period of 14 minutes 47 seconds of incessant thunder. At 22h. 47m. my father and I were observing the storm, which was then nearly overhead, slightly to south-west, and very severe. A very bright flash occurred and my father, who was facing the flash, reported a " pop," almost simultaneous with it. I was in the doorway writing down a report with my back to the flash. I only saw the reflection and did not hear the " pop." The crash of thunder did not come for at least half a second.

It is difficult to judge between the theories about the " vit " or " click." The reason why I did not hear the " vit " may have been that I did not see the flash, this giving support to the physiological theory. This, however, is upset by the fact that I had just been out in the open and had heard no " vit " with even more severe discharges. On this occasion the theory of induced charges sparking from one object to another is untenable, as the " click " was distinctly heard to the south-west and in that direction there is nothing but a thick wood. Finally, Mr. Best's theory in the *Meteorological Magazine* of July, 1928, p. 135, is hardly adequate to explain such observations as that described by Mr. Absalom in the magazine of August, 1928, p. 163, in which three people heard a " crack " and in the same direction. It is unlikely that three people would all receive the induced charge in the head, and that it would escape in each case so as to give the same apparent direction.

The best way of attempting to settle the matter is for someone to collect data of as many occurrences as possible, and to note the severity of storm, weather, direction with regard to the lightning flash, number of people who heard it, and so on.

In conclusion, it may be of interest to note that on July 22nd there was a distant thunderstorm at 17h. 24m. to the south, and at that time I was on a roof and distinctly saw a lightning flash low down to the south, but not followed by audible thunder. The sky was heavily overcast, but it was not raining, and it was long before sunset. This is the only case I have of lightning without thunder in the daytime.

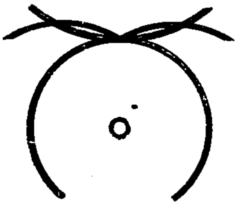
S. E. Ashmore.

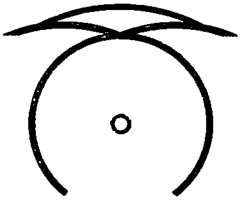
22, Soho Road, Handsworth, Birmingham. September 25th, 1932.

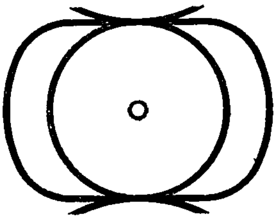
Supplementary Tangent Arcs to the 22° Halo

The Padstow halo complex of May 10th last, as discussed in the *Meteorological Magazine* for July, was *inter alia* noted for the presence of upper and lower tangent arcs supplementary to the usual circumscribed halo which owing to the elevation of the sun, 51°, was fully developed. The question arises what these supplementary arcs represent.

In the discussion it was suggested that they might be the upper and lower Parry arcs. There is, however, a difficulty in this. The lower arc might be the Parry arc but the upper arc was of reversed curvature to the Parry arc, which though nearly flat has a slight curvature concave to the sun. Moreover as Wegener's table shows, at a little less elevation than 50° the middle of the Parry arc falls together with the apex of the 22° halo; as Meyer says, " wenn die Sonne auch nur annahernd in dieser Hohe über dem Horizont steht, ist wenig Aussicht vorhanden den Bogen von Parry zu erkennen." (Even if the sun is only approximately at this altitude above the horizon, there is little prospect that the Parry arc will be recognisable.)


Halo, Ben Nevis, March 4th, 1887, showing supplementary (Kalmar?) tangent arc. Elevation of sun about 24°.


Halo, Boulder Colorado, January 10th, 1918, showing Parry arc. Elevation of sun 19° 15′.


Padstow halo of May 10th, 1932, showing Kalmar arcs. Elevation of sun 51°.

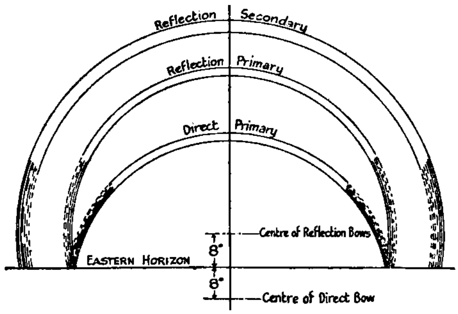
What then might the arcs be? It has been suggested that they might be called the Kalmar arcs after the observer of the very similar Pola complex in 1896. It seems they must have a separate existence from the Parry arcs as an arc very like the upper Kalmar arc was observed at Ben Nevis, March 4th, 1887, at an elevation much lower than the Padstow complex and at which the Parry arc if present would have been conspicuous.

Cicely M. Botley.

Guildables, 17, *Holmesdale Gardens, Hastings*. *August* 20*th*. 1932.

Reflection Rainbows

At about 8 p.m. on August 21st, while walking about a mile north of Bude (which faces due west) and a mile inland, I saw the bright lower limbs of a rainbow formed by the reflection of the setting sun from the surface of a calm sea. The sun itself, at an altitude of about 8°, was at first obscured by clouds which shortly cleared somewhat and allowed a direct bow to appear. Parts of a moderately bright reflection secondary were visible, but I could not see any part of a direct secondary. The direct primary and reflection primary met, as would be expected, on the eastern horizon, the direct primary making an acute angle, and the reflection primary an obtuse angle, with the horizon. Thus, parts of three bows were visible. My altitude was about 100 feet above ordnance datum.



I do not know whether this phenomenon is common, but the conditions were perhaps rather unusual—a stormy sky, calm sea with westerly aspect, and light clouds moderating the rays of the sun direct to the observer but not obscuring the rays falling on the sea.

The enclosed sketch is roughly to scale, the radii being taken at the theoretical values of about 42° and 51° for the red rays and 40° and 54° for the violet rays of the primary and secondary bows respectively. Orange and red are represented by broken lines, blue and violet by full lines; portions not visible are left blank. The angle of the reflection bows appeared to be more obtuse than that on the sketch.

W. D. Reynolds.

11, *Victoria Street, London, S. W.*1. *September* 9*th*, 1932.

Vivid Meteor seen from Eskdalemuir

An unusually bright meteor was observed at Eskdalemuir, at 18h. 31m. G.M.T. on Monday evening, September 26th, 1932. Although it was quite light, between sunset and night, the colours were most vivid. The head of the meteor was like a brilliant electric blue rod, which gradually diverged into a yellow and yellowish-brown tail from which small globules were streaming.

When first seen it was due east of the Observatory, moving rapidly towards the south in a straight line at an elevation of 40°. After being visible for about three seconds it disappeared in a direction east-south-east from the observatory.

At the time of vision the wind was north by east, with velocity 5 metres per second.

R. E. Watson.

The Observatory, Eskdalemuir, Dumfriesshire. October 3rd, 1932.

Line Squall in Cornwall

At about 15h. 15m. G.M.T. this afternoon there was a line squall in the north-west. It lasted about 15 minutes. The background was of very black nimbus cloud surmounted by a swirling tapering cumulus cloud. Some spectators declared it to be a waterspout; but it did not touch earth or water anywhere. It looked very much like the picture of a line squall which appears in the front of the Meteorological Log Book as supplied to the Nautical College, Pangbourne.

E. Michael Shaw.

St. John's Vicarage, Penzance, Cornwall. September 9th, 1932.

Extremes of Heat in August

In criticizing the assumption made by "the meteorological correspondent of an important newspaper" that if meteorological conditions *precisely similar* to those of August 19th last had happened to obtain in July the temperature of 99°F. registered at Greenwich on that date would have been exceeded, Mr. Bonacina clearly does not allow the words italicized their full force. "Precisely similar" can only mean "identical in every respect"—that is, with regard not merely to the distribution through the troposphere of pressure, temperature, humidity, radiation and cloudiness, but also to the thermal state of soil, sea and stratosphere. It is surely conceivable that after a period of exceptional warmth from, say, May to the beginning of July all these factors might arrive at the same combination as on August 19th this year a month or six weeks earlier. In that event, still greater heat would necessarily result from the increased altitude (eight to ten degrees) of the sun Some approach to this earlier maturing of the appropriate conjunction of circumstances appears to have occurred in 1868. In south-east England the May of that year was nearly as warm as an average June, and June was fully as warm as an average July. Around the middle of July temperatures above 95°F. were recorded as far north as Manchester. On the 22nd, although the reading at Greenwich was not above 96.6°F., 100.5°F. was attained by a verified thermometer in a "box stand, double, with venetian sides" at Tonbridge; on the previous day 99.9°F. was the maximum given by a similar instrument exposed on a Glaisher stand at Abingdon Pigotts, Royston, Cambs.*

Experience suggests to Mr. Bonacina that "August, though averaging a little cooler than July, is actually the month for spurts of extreme heat." It is true that the two highest maximum temperatures on record at Greenwich back to 1841 were registered on August 9th, 1911, and August 19th, 1932; but prior to 1911 the August extreme was 95.1°F. (on the 18th of the month in 1893), and this was substantially exceeded by 96.6°F. on July 22nd, 1868, and by 97.1°F. on July 15th, 1881. Since 1841, the greatest heat of the summer has occurred at Greenwich 42 times in July, as against 23 times in August. Furthermore, out of a total of 88 days with maxima at or above 90.0°F., July has provided 47, August 25. There would seem to be no evidence that the applicability of Mr. Bonacina's remark quoted above extends beyond the reign of King George V.

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* See *Symons's Meteorological Magazine,* 3, 1868, p. 130.

THE METEOROLOGICAL CORRESPONDENT IN QUESTION.
September 30th, 1932.

NOTES AND QUERIES

Flying through a Haboob

An Imperial Airways pilot, Mr. C. G. Lumsden, flying north from El Dueim towards Khartoum on May 31st, 1932, encountered a haboob about 60 miles north of El Dueim. From a distance of about 40 miles and a height of 4,000 feet the appearance was of a buttressed hill rising vertically for 2,000 feet to a gently inclined surface which appeared to merge into disturbed cirrus at 8,000 feet. The vertical wall was composed of sand, advancing westward at the ground under the influence of an east wind of about 35 m.p.h. At 5,000 feet, however, there was no violent wind, and the pilot passed into the haboob between two advanced buttresses. Here visibility dropped to half a mile, there were no bumps, but rain fell although there were no well-defined clouds. Behind the front visibility improved rapidly, and at ten miles' distance it reached ten miles. The length of the front was 25 miles; at its northern edge the wind changed to south, 40 m.p.h., subsequently becoming light and variable.

Hurricane in eastern United States

Mr. Earl C. Austin, of Auburn, Maine, writes that a tropical hurricane from the Gulf of Mexico crossed the eastern parts of the United States of America on September 14th to 17th causing gales and heavy rain; 16.5 in. fell at Appalachicola, Florida, in 36 hours. The storm followed an unusual track; after reaching the coast off the Virginia Capes it turned inland again under the influence of a high to the north-east, and crossed Maine with renewed intensity. Auburn, Maine, received 5.50 in. in 20 hours, Woonsocket, Rhode Island, 9.80 in. and Greenville on Moosehead Lake, 7.40 in., the highest recorded falls in a day at these places. Great damage was caused by floods, many bridges being washed away, while boats were sunk by the high waves on the inland lakes.

Hurricane in Porto Rico

The hurricane which devastated the island of Porto Rico on the night of September 26th-27th appears, according to reports in *The Times*, to have been one of the most intense ever experienced there. Altogether 212 lives were lost, 1,800 persons were injured, and damage to property estimated to exceed ten million dollars occurred on Porto Rico alone; considerable material damage is reported on Barbuda and Santo Domingo, but no loss of life.

The " hurricane season " of the West Indies is at its height in August and September. According to data collected by Mr. O. Fassig, 64 hurricanes were recorded in the vicinity of Porto Rico in the period 1515 to 1929; of these, four of calamitous nature occurred in a period of 130 years, and the most recent of them on September 13th, 1928, when nearly 300 lives were lost. On August 8th, 1899, a severe hurricane occurred, in which it was estimated that 3,000 lives were lost.

The development of wireless telegraphy and the improvement of communication with the outlying districts have had the effect of diminishing the loss of life in these major hurricanes, since the more adequate warning now possible enables the inhabitants to take precautions against the floods which were responsible for great loss of life in the past.

Meteorological Lectures

A course of illustrated lectures and discussions on " The Science of the Weather " is to be given by Mr. L. B. Cundall, at the City Literary Institute, Goldsmith Street, on Thursday evenings at 8 p.m. The course, which will continue through the winter, deals with the physical properties of the atmosphere, instrumental and non-instrumental observations, the weather map, forecasting and climatology. The opening date has not yet been arranged.

Reviews

The Climate of the Netherlands—B (continued). Air- and earth-temperature. By Dr. C. Braak, K. Ned. Meteor. Inst., No. 102. Med. en Verh. 33, pp. 55 (Dutch) + 20 (English summary). *Illus.* Amsterdam, Seyffardt's Bockhandel, 1930.

This section of the official handbook on the climate of the Netherlands deals chiefly with the distribution of air temperatures, mean, maximum and minimum, over the country. An interesting diagram shows the daily mean temperature over various periods of years, and is used in the investigation of the occurrence of cold and warm spells. Dr. Braak concludes that " the reality of constant deviations cannot be denied without further research,'' but it appears also that '' the trace of the Ice Saints in the beginning of May cannot be detected with certainty in the curve for 1849-1929, so that the question of cold spells '' appears to be one on which general agreement is impossible.

The summary is written in Dr. Braak's usual easy English style, and in conjunction with the earlier parts of the same series gives a most valuable account of temperature conditions in the Netherlands.

S. T. A. MIRRLEES.

Maps showing the rainfall for each month and for the year 1930 *in Australia and Tasmania.* Published by the Commonwealth Meteorologist. 1931. Official—not for sale.

The annual rainfall amounts varied from 2·46 in. in Central Australia to 208·37 in. in Queensland. As much as 63 per cent. of the whole area received more than the average rainfall. Small-scale maps show the area with a rainfall in excess of the average for each year back to 1908. So large an area has been affected only in the years 1910, 1917 and 1921, when the areas with rainfall above the average were 75, 75 and 63 per cent. The rainfall of 1930 was in marked contrast to that of 1928 and 1929, which gave only 13 and 15 per cent. of the whole area with rainfall in excess of the average. These two years gave some of the smallest totals ever experienced in parts of the pastoral country of the eastern interior. The fluctuations in the rainfall experienced in Australia from year to year are similar to those in this country in that excesses or deficiencies but rarely cover the whole country.

The rainfall was, on the whole, well distributed throughout the year, and the pastoral and agricultural position, from the standpoint of production, was generally satisfactory at the close of 1930.

J. GLASSPOOLE.

Obituary

Mr. J. Sheerman.—We regret to learn of the death of Mr. J. Sheerman, on September 27th. Mr. Sheerman was born on March 12th, 1853 and joined the staff of the Meteorological Office in February, 1882. At that time the project of analysing the autographic records obtained at the Meteorological Office Observatories was being vigorously pursued, and the harmonic analyser now in the Museum was built for that purpose. Mr. Sheerman was appointed for this work on account of his proficiency in harmonic analysis, and became the official expert in the use of the machine. The department was then known as the '' Pantagraph Room.'' Mr. Sheerman retained these statistical associations throughout his career, and when the actual reproduction of the autographic curves was given up, he became responsible for the production of the annual volumes of *Hourly Readings* in which they were tabulated. He also took part in the preparation of the statistical summaries of the meteorological observations obtained during the National Antarctic Expedition of 1902-4.

After he became a Principal Assistant in 1914, Mr. Sheerman had a considerable share in the production of the meteorological sections of the British *Year Book*, until he retired on December 31st, 1919. Thus for a period of nearly 38 years he played a large part in providing the indispensable basis of accurately summarised and digested observations, on which all meteorological investigations must rest.

News in Brief

Col. E. Meseguer has relinquished the post of Director of the Spanish Meteorological Service as a result of his appointment as Inspector-General of the Surveying Department. He is succeeded by Dr. Nicolas Sama, chief of the Forecasting Service.

The Weather of September, 1932

Pressure was below normal generally over Europe and America except over California, a belt extending from north-western United States across north-eastern Canada to Greenland and the central North Atlantic and over a small area in south Russia. Pressure was also above normal to the north-east of the Caspian Sea. The greatest excess was 8.1mb. at Julianehaab and the greatest deficits were 13.6mb. at Vardo, 8.7mb. at 40°N., 70°W. and 5.0mb. at Point Barrow. Temperature was greatly above normal in central Europe, about normal in Scandinavia, slightly above normal in Spitsbergen and below normal in Portugal. Rainfall was below normal in central Europe and Spitsbergen, but above normal in Scandinavia where the excess was 130 per cent in northern Lapland, and 84 per cent in Scania.

The weather of September over the British Isles was variable. There was a dearth of sunshine except in the north-eastern coastal areas and an excess of rain except in the south-eastern coastal areas and in south-west Ireland. The total sunshine of 109 hours at Gorleston was the lowest September figure since records began there in 1908. The first ten days were very unsettled with considerable rain in most districts, notably from the 1st-3rd, the 7th-8th, and again on the 10th; 2.75in. fell at Borrowdale (Cumberland) on the 1st, 2.80in. at Tynywaun (Glamorgan) on the 2nd, and 1.69in. at Watlington (Oxford) on the 8th. The first two nights were unusually warm with minima of from 60°F. to 65°F. in many places, the reading of 64°F. at Kew on the night of the

2nd being a September record since 1871. After the 2nd there was a marked drop in temperature as the winds came from a northerly source, but on the 6th and 9th maxima again rose locally above 70°F. in the south. The 7th and 9th were sunny days, with 10.6hrs. at Norwich and Sheffield on the 7th and 11.2hrs. at Ilfracombe on the 9th. Thunderstorms occurred locally from the 7th-10th. The best weather of the month was enjoyed from the 12th-17th when an anticyclone passed slowly eastwards across the British Isles and central and southern. Europe. Sunshine records were frequently good especially on the 12th and 16th; at Inchkeith 11.2hrs. bright sunshine were recorded on the 12th. There was a progressive rise in temperature in most places, the two highest temperatures reported were 80°F. at Tunbridge Wells on the 16th and 79°F. at Aberdeen on the 15th. Much fog occurred locally on the 16th and 17th. During the evening of the 17th a depression to the north-west of Scotland deepened considerably as it moved slowly eastwards, and cold northerly winds spread over the country. Pressure continued low until the 26th, and the weather cool and unsettled with bright periods. The 20th was sunny in Scotland and Ireland, giving 11.1hrs. at Aldergrove and the 21st sunny over the kingdom generally, giving 10.9 hrs. at Rothamsted and Winchester. Rainfall was scarce in south Scotland and north England but heavy at times in the south; Margate had 1.02in. on the 22nd. Maximum temperatures were well below 60°F. and sharp ground frosts occurred locally; 17°F. was registered at Renfrew on the 21st. From the 26th to 29th an anticyclone passed across the country giving mainly fair sunny weather, 10.5hrs. at Cardiff on the 26th and at Collumpton on the 28th, with ground frosts locally. By the 29th a depression was approaching the English Channel, temperature rose slowly and rain fell heavily in south-west England on the 29th and over the kingdom generally on the 30th. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	93	—22	Liverpool	128	0
Aberdeen	137	+13	Ross-on-Wye	128	— 8
Dublin	110	—29	Falmouth	99	—64
Birr Castle	99	—27	Gorleston	109	—53
Valentia	114	—19	Kew	103	—42

Miscellaneous notes on weather abroad culled from various sources.

A storm of unusual violence broke over Marseilles on the 9th causing considerable floods in parts of the city and many animals were destroyed. A severe storm swept across southern Ticino, Switzerland, on the 22nd where vineyards and crops were ruined and many landslides occurred. A forest fire continued in the mountains near Amsteg in Uri (Switzerland) during the week ending the 24th in spite of the heavy rainfall on the 18th. Thunderstorms and heavy rain during the 28th and 29th did much damage along the Riviera coast from Fréjus to Nice. The month of September up to the 26th proved one of the hottest and driest for many years in Austria (*The Times*, September 12th-26th).

Floods made a breach of 50yds. in the Madras railway near Poona at the beginning of the month. General rains fell in the Central Provinces and Berars and in the United Provinces early in the month, while local rains were reported in Gujerat. Towards the later part of the month the monsoon was active in Burma and north-east India, and later still it was gradually withdrawing from the interior of the country. Gales occurred in Syria and Palestine about the 17th (*The Times*, September 2nd-30th).

Rain delayed harvesting in some parts of Canada at the beginning of the month, but the weather had cleared by the 10th and favourable conditions for harvesting were experienced during the following week. A severe gale swept down the Annapolis Valley (Nova Scotia) on the 17th, destroying much of the apple crop. On the 5th a hurricane swept across the Bahamas, the winds reached their greatest strength over Abaco Island where much damage was done, 14 people were killed, including 5 drowned by tidal wave. A hurricane swept across the Virgin Islands on the 26th and then passed across Porto Rico and Santo Domingo.* A storm passing to the north side of Jamaica on the 29th destroyed many banana trees. The Rio Grande River overflowed its banks early in the month and serious floods occurred between Penitas and Rio Grande City, Texas. Temperature was considerably above normal in the eastern United States, the Lake Region and Ohio Valley at the beginning of the month, reaching 92°F. at New York on the 2nd. A cooler spell then passed eastwards across the States followed by another warm spell. Rainfall was generally below normal except early in the month in the Gulf States and locally along the Atlantic coast about the middle of the month.† (*The Times*, September 3rd-30th, and *Washington, D.C., U.S. Dept. Agric. Daily Weather Map and Weekly Weather and Crop Bulletin.*)

Rainfall, September, 1932—General Distribution

England and Wales	144	per cent of the average 1881-1915.
Scotland	137	
Ireland	109	
British Isles	135	

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* See p. 217.

† See p. 216.

Rainfall: September, 1932: England and Wales.

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Lond .	Camden Square	2·56	141	*Leics* .	Belvoir Castle	1·95	104
Sur .	Reigate, Alvington	2·04	102	*Rut* .	Ridlington	3.68	192
Kent .	Tenterden, Ashenden	1·85	86	*Lincs* .	Boston, Skirbeck	2·39	136
,, .	Folkestone, Boro. San.	2·27	...	,,	Cranwell Aerodrome	2·01	113
,, .	Margate, Cliftonville	1·93	98	,, .	Skegness, Marine Gdns	2·50	138
,, .	Sevenoaks, Speldhurst	2·03	...	,, .	Louth, Westgate	2·09	103
Sus .	Patching Farm	3·12	130	,, .	Brigg, Wrawby St.	1·66	...
,, .	Brighton, Old Steyne	2·35	112	*Notts* .	Worksop, Hodsock	1·29	85
,, .	Heathfield, Barklye	3·27	133	*Derby* .	Derby, L. M. & S. Rly.	2·02	122
Hants .	Ventnor, Roy. Nat. Hos.	3·43	138	,, .	Buxton, Devon Hos.	4·22	130
,, .	Fordingbridge, Oaklnds	3·91	182	*Ches* .	Runcorn, Weston Pt.	2·49	93
,, .	Ovington Rectory	3·70	162	,, .	Nantwich, Dorfold Hall	2·20	...
,, .	Sherborne St. John	3·16	154	*Lancs* .	Manchester, Whit Pk.	3·29	138
Berks .	Wellington College	2·43	132	,, .	Stonyhurst College	7·84	205
,, .	Newbury, Greenham	3·73	185	,, .	Southport, Hesketh Pk	4·16	151
Herts .	Welwyn Garden City	1·71	...	,, .	Lancaster, Strathspey	5·31	...
Bucks .	H. Wycombe, Flackwell	2·54	...	*Yorks* .	Wath-upon-Dearne	1·23	78
Oxf .	Oxford, Mag. College	2·39	142	,, .	Bradford, Lister Pk.	2·81	136
Nor .	Pitsford, Sedgebrook	3·07	171	,, .	Oughtershaw Hall	9·16	...
,, .	Oundle	2·39	...	,, .	Wetherby, Ribston H.	2·32	129
Beds .	Woburn, Crawley Mill	2·01	112	,, .	Hull, Pearson Park	1·67	97
Cam .	Cambridge, Bot. Gdns.	1·69	105	,, .	Holme-on-Spalding	2·27	...
Essex .	Chelmsford, County Lab	1·81	105	,, .	West Witton, Ivy Ho.	3·33	155
,, .	Lexden Hill House	1·50	...	,, .	Felixkirk, Mt. St. John	2·37	130
Suff .	Haughley House	1·10	...	,, .	Pickering, Hungate	2·60	136
,, .	Campsea Ashe	1·48	77	,, .	Scarborough	2·25	126
Norf .	Norwich, Eaton	...	...	,, .	Middlesbrough	2·19	132
,, .	Wells, Holkham Hall	2·47	130	,, .	Balderdale, Hury Res.	4·35	174
,, .	Swaffham, The Villa	1·96	89	*Durh* .	Ushaw College	2·39	119
Wilts .	Devizes, Highclere	3·64	178	*Nor* .	Newcastle, Town Moor	2·29	112
,, .	Bishops Cannings	3·91	178	,, .	Bellingham, Highgreen	4·72	217
Dor .	Evershot, Melbury Ho.	5·21	196	,, .	Lilburn Tower Gdns.	4·76	202
,, .	Creech Grange	3·86	141	*Cumb* .	Geltsdale	5·71	...
,, .	Shaftesbury, Abbey Ho.	3·06	126	,, .	Carlisle, Scaleby Hall	4·52	167
Devon .	Plymouth, The Hoe	5·58	101	,, .	Borrowdale, Seathwaite	14·50	154
,, .	Launceston, Werringt'n	5·63	...	,, .	Borrowdale, Moraine	11·55	...
,, .	Holne, Church Pk. Cott.	7·38	205	,, .	Keswick, High Hill	6·98	...
,, .	Cullompton	5·34	237	*West* .	Appleby, Castle Bank	3·76	148
,, .	Sidmouth, Sidmount	3·95	172	*Glam* .	Cardiff, Ely P. Stn.	5·13	165
,, .	Filleigh, Castle Hill	6·23	...	,, .	Treherbert, Tynywaun	11·79	...
,, .	Barnstaple, N. Dev. Ath	4·80	178	*Carm* .	Carmarthen Friary	4·34	125
,, .	Dartm'r, Cranmere Pool	10·80	...	*Pemb* .	Haverfordwest, School	3·43	96
Corn .	Redruth, Trewirgie	4·94	158	*Card* .	Aberystwyth	3·52	...
,, .	Penzance, Morrab Gdn.	5·13	175	,, .	Cardigan, County Sch.	3·03	...
,, .	St. Austell, Trevarna	5·46	171	*Brec* .	Crickhowell, Talymaes	4·20	...
Soms .	Chewton Mendip	7·29	237	*Rad* .	Birm W.W. Tyrmynydd	4·39	114
,, .	Long Ashton	5·82	243	*Mont* .	Lake Vyrnwy	6·77	190
,, .	Street, Millfield	4·38	194	*Denb* .	Llangynhafal	2·70	122
Glos .	Blockley	3·11	...	*Mer* .	Dolgelly, Bryntirion	6·68	157
,, .	Cirencester, Gwynfa	3·42	155	*Carn* .	Llandudno	2·95	129
Here .	Ross, Birchlea	3·65	190	,, .	Snowdon, L. Llydaw 9	17·15	...
,, .	Ledbury, Underdown	3·31	173	*Ang* .	Holyhead, Salt Island	2·69	100
Salop .	Church Stretton	2·63	129	,, .	Lligwy	4·37	...
,, .	Shifnal, Hatton Grange	2·01	104	*Isle of Man*			
Worc .	Ombersley, Holt Lock	2·47	139		Douglas, Boro' Cem.	4·78	145
War .	Birminghm, Edgbaston	3·00	168	*Guernsey*			
Leics .	Thornton Reservoir	2·49	138		St. Peter P't. Grange Rd	4·59	176

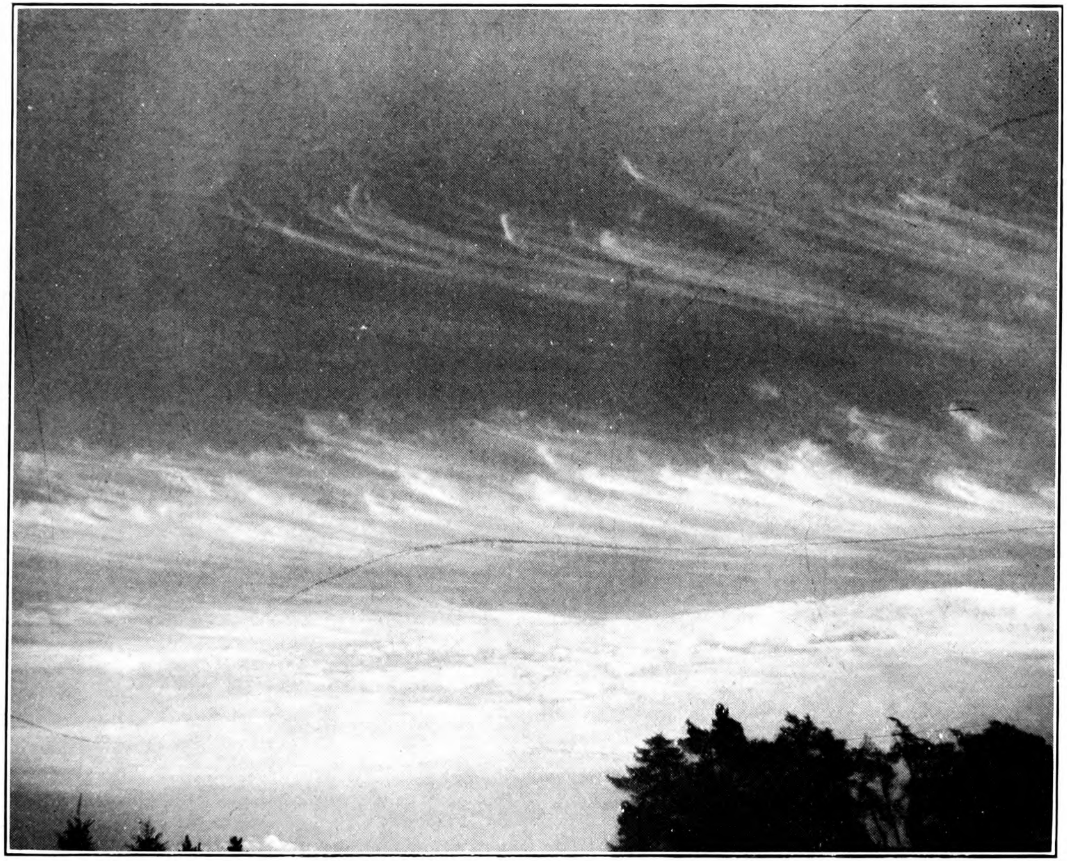
Rainfall: September, 1932: Scotland and Ireland.

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Wigt	Pt. William, Monreith	6·16	211	*Suth*	Melvich	4·99	...
,,	New Luce School	5·23	146	,,	Loch More, Achfary...	14·78	257
Kirk	Carsphairn, Shiel	8·61	162	*Caith*	Wick	3·82	153
Dumf	Dumfries, Crichton, R.I	4·05	...	*Ork*	Pomona, Deerness	...	...
,,	Eskdalemuir Obs.	6·20	168	*Shet*	Lerwick	5·09	169
Roxb	Branxholm	4·18	187	*Cork*	Caheragh Rectory	2·40	...
Selk	Ettrick Manse	5·32	147	,,	Dunmanway Rectory	3·36	82
Peeb	West Linton	4·10	...	,,	Ballinacurra	2·04	81
Berw	Marchmont House	3·54	147	,,	Glanmire, Lota Lo	2·03	72
E.Lot	North Berwick Res.	2·14	102	*Kerry*	Valentia Obsy	2·56	62
Midl	Edinburgh, Roy. Obs.	2·48	121	,,	Gearahameen	5·80	...
Lan	Auchtyfardle	4·49	...	,,	Killarney Asylum	2·67	75
Ayr	Kilmarnock, Kay Pk.	4·75	...	,,	Darrynane Abbey	2·82	79
,,	Girvan, Pinmore	5·59	146	*Wat*	Waterford, Gortmore...	1·61	59
Renf	Glasgow, Queen's Pk.	4·87	176	*Tip*	Nenagh, Cas. Lough	4·38	156
,,	Greenock, Prospect H.	5·77	121	,,	Roscrea, Timoney Park	2·74	...
Bute	Rothesay, Ardencraig.	4·96	...	,,	Cashel, Ballinamona...	1·84	75
,,	Dougarie Lodge	4·37	...	*Lim*	Foynes, Coolnanes	3·85	138
Arg	Ardgour House	12·26	...	,,	Castleconnel Rec.	4·08	...
,,	Glen Etive	...	...	*Clare*	Inagh, Mount Callan...	...	...
,,	Oban	5·10	116	,,	Broadford, Hurdlest'n.	4·59	...
,,	Poltalloch	4·55	100	*Wexf*	Gorey, Courtown Ho...	1·87	76
,,	Inveraray Castle	8·57	134	*Kilk*	Kilkenny Castle	1·45	63
,,	Islay, Eallabus	5·32	127	*Wick*	Rathnew, Clonmannon	1·42	...
,,	Mull, Benmore	...	...	*Carl*	Hacketstown Rectory..	2·35	84
,,	Tiree	...	...	*Leix*	Blandsfort House	2·56	94
Kinr	Loch Leven Sluice	2·68	104	,,	Mountmellick	...	...
Perth	Loch Dhu	5·15	90	*Offaly*	Birr Castle	3·71	162
,,	Balquhidder, Stronvar	4·24	...	*Kild'r.*	Monasterevin	2·26	...
,,	Crieff, Strathearn Hyd.	2·05	72	*Dublin*	Dublin, FitzWm. Sq....	2·22	116
,,	Blair Castle Gardens...	1·92	81	,,	Balbriggan, Ardgillan.	2·01	99
Angus	Kettins School	1·76	88	*Meath*	Beauparc, St. Cloud...	3·58	...
,,	Dundee, E. Necropolis	1·56	75	,,	Kells, Headfort	3·47	130
,,	Pearsie House	1·68	...	*W.M*	Moate, Coolatore	4·07	...
,,	Montrose, Sunnyside...	2·27	114	,,	Mullingar, Belvedere...	4·17	156
Aber	Braemar, Bank	2·65	105	*Long*	Castle Forbes Gdns....	3·30	115
,,	Logie Coldstone Sch....	3·58	154	*Gal*	Ballynahinch Castle...	4·86	102
,,	Aberdeen, King's Coll.	3·59	162	,,	Galway, Grammar Sch.	...	...
,,	Fyvie Castle	3·65	140	*Mayo*	Mallaranny	5·36	...
Moray	Gordon Castle	3·34	134	,,	Westport House	4·32	122
,,	Grantown-on-Spey	3·80	153	,,	Delphi Lodge	8·01	106
Nairn.	Nairn	2·22	101	*Sligo*	Markree Obsy	4·66	138
Inv's	Ben Alder Lodge	4·41	...	*Cavan.*	Belturbet, Cloverhill...	3·50	141
,,	Kingussie, The Birches	2·61	...	*Ferm*	Enniskillen, Portora...	...	...
,,	Loch Quoich, Loan	...	...	*Arm*	Armagh Obsy	3·11	126
,,	Glenquoich	12·93	150	*Down*	Fofanny Reservoir	3·38	...
,,	Inverness, Culduthel R.	3·41	...	,,	Seaforde	2·75	100
,,	Arisaig, Faire-na-Squir	6·11	...	,,	Donaghadee, C. Stn....	3·20	134
,,	Fort William, Glasdrum	6·83	...	,,	Banbridge, Milltown...	2·56	104
,,	Skye, Dunvegan	6·60	...	*Antr*	Belfast, Cavehill Rd....	3·94	...
,,	Barra, Skallary	4·72	...	,,	Glenarm Castle	5·56	...
R & C	Alness, Ardross Castle	3·93	135	,,	Ballymena, Harryville	3·78	121
,,	Ullapool	5·23	140	*Lon*	Londonderry, Creggan	4·20	127
,,	Achnashellach	12·94	...	*Tyr*	Omagh, Edenfel	4·79	157
,,	Stornoway	4·76	121	*Don*	Malin Head	3·29	...
Suth	Lairg	4·28	151	,,	Dunfanaghy	4·50	...
,,	Tongue	5·19	164	,,	Killybegs, Rockmount.	5·41	118

Climatological Table for the British Empire, April, 1932

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Per-centage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F	° F.	%	0—10	in.	in.			
London. Kew Obsy.	1008·1	— 6·3	65	33	52·3	39·7	46·0	— 1·3	41·4	84	7·4	2·23	+ 0·78	22	3·9	28
Gibraltar	1016·9	+ 0·4	77	46	68·5	51·4	59·9	— 1·1	51·2	83	4·4	4·04	+ 1·36	9	..	..
Malta	1015·4	+ 2·0	74	45	64·6	53·9	59·3	— 1·6	54·6	74	4·7	0·15	— 0·71	2	9·4	72
St. Helena	1013·1	0·0	72	59	68·2	60·5	64·3	— 1·0	60·7	91	8·5	0·68	..	10	..	..
Sierra Leone	1012·0	+ 1·2	90	70	87·7	74·4	81·1	— 1·3	76·0	78	5·1	8·71	+ 4·65	12	..	..
Lagos, Nigeria	1009·5	+ 0·1	92	72	88·8	78·2	83·5	+ 0·7	78·8	78	8·0	3·80	— 2·28	9	7·1	58
Kaduna, Nigeria	1008·7	— 3·0	102	65	97·2	71·9	84·5	+ 3·0	73·9	61	5·7	1·24	— 1·84	5	8·5	69
Zomba, Nyasaland	1011·5	— 1·0	85	59	79·6	64·0	71·8	+ 2·5	..	80	7·6	2·95	— 0·71	7	..	..
Salisbury, Rhodesia	1015·6	— 0·2	81	46	76·5	55·0	65·7	0·0	58·8	68	5·0	2·83	+ 1·84	13	5·5	47
Cape Town	1013·8	— 2·6	91	42	78·0	57·7	67·9	+ 4·7	59·4	86	4·5	0·33	— 1·54	3	..	..
Johannesburg	1016·4	+ 1·1	78	45	73·0	52·4	62·7	+ 2·7	52·0	56	2·8	1·47	— 0·27	5	8·5	74
Mauritius	1013·1	— 0·9	84	63	81·0	71·2	76·1	+ 0·3	73·0	77	6·2	13·83	+ 9·36	26	6·8	59
Calcutta, Alipore Obsy.	1006·8	+ 0·5	105	70	98·4	76·5	87·5	+ 1·9	76·0	77	1·8	1·07	— 1·11	4*	..	..
Bombay	1009·4	+ 0·6	94	75	89·4	77·4	83·4	+ 0·3	75·7	75	3·9	0·00	— 0·05	0*	..	..
Madras	1008·8	+ 0·4	102	70	92·1	76·5	84·3	— 1·0	77·5	74	4·4	0·58	— 0·05	3*	..	..
Colombo, Ceylon	1010·1	+ 1·4	89	73	87·2	76·3	81·7	— 1·0	78·4	78	7·0	11·27	+ 1·54	15	7·2	59
Singapore	1009·5	+ 0·6	92	71	87·4	74·1	80·7	— 0·9	77·5	81	6·8	6·37	— 1·26	17	5·6	46
Hongkong	1012·6	0·0	86	62	75·2	67·6	71·4	+ 0·6	68·2	85	9·1	3·70	— 1·95	11	3·1	25
Sandakan	..	..	90	73	86·7	75·5	81·1	— 1·1	77·6	82	..	12·10	+ 7·61	12	..	..
Sydney, N.S.W.	1015·1	— 3·3	82	48	72·7	57·6	65·1	+ 0·4	59·7	77	5·3	3·49	— 2·03	17	6·5	58
Melbourne	1015·2	— 4·3	78	43	67·2	52·5	59·9	+ 0·4	55·1	82	7·8	5·42	+ 3·25	21	3·7	33
Adelaide	1016·2	— 3·7	79	47	69·5	54·3	61·9	— 2·0	56·0	69	7·9	4·63	+ 2·90	16	3·6	32
Perth, W. Australia	1017·1	— 1·3	87	48	74·4	57·2	65·8	— 1·0	57·6	65	5·2	3·16	+ 1·51	14	6·3	56
Coolgardie	1017·5	— 1·1	87	42	75·9	52·6	64·3	— 0·7	54·7	56	3·9	1·15	+ 0·19	5	..	..
Brisbane	1015·1	— 2·5	88	54	79·6	64·2	71·9	+ 1·6	64·9	70	5·6	5·36	+ 1·82	15	6·3	55
Hobart, Tasmania	1013·0	— 1·8	70	43	60·2	50·0	55·1	— 0·1	51·1	77	8·0	3·10	+ 1·25	19	2·9	27
Wellington, N.Z.	1019·0	+ 0·9	70	40	60·7	50·8	55·7	— 1·4	53·2	81	7·0	2·69	— 1·19	15	4·4	40
Suva, Fiji	1010·2	— 0·4	89	68	83·7	73·3	78·5	— 0·1	74·5	81	7·2	11·51	— 0·70	22	4·7	40
Apia, Samoa	1008·1	— 1·8	90	70	85·2	74·6	79·9	+ 1.0	76·9	82	6·9	12·81	+ 2·66	23	5·3	45
Kingston, Jamaica	1011·9	— 2·2	89	69	86·0	72·0	79·0	+ 0·6	71·3	83	4·4	2·84	+ 1·60	12	6·7	54
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1015·1	— 1·0	76	20	48·2	33·4	40·8	— 1·3	34·7	65	6·1	1·75	— 0·54	9	5·4	40
Winnipeg	1020·7	+ 4·0	72	—18	47·2	29·4	38·3	+ 0·6	..	..	5·7	0·92	— 0·48	6	..	..
St. John, N.B.	1010·9	— 2·5	66	24	47·4	32·3	39·9	+ 0·9	35·2	71	5·9	2·98	— 0·53	10	5·4	40
Victoria, B.C.	1014·5	— 3·0	63	39	54·7	43·5	49·1	+ 1·2	46·1	80	6·7	1·16	— 0·36	12	6·1	45

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.



DELICATE CIRRUS IN THE FORM OF HOOKS (CIRRUS UNCINUS) (see p. 227)
reproduced by permission of *C. J. P. Cave Esq.*

M.O. 347.

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The new International Atlas of Clouds and of States of the Sky

Much cloud has passed across the sky since the appearance of the first International Atlas of Clouds in 1895. That work, prepared by Hildebrandsson, Riggenbach, and Teisserenc de Bort, provided a systematic classification—based partly upon the form and partly upon the height of the cloud—into which all the observed forms of cloud might be fitted. How effective this classification has proved during the thirty-six years since its introduction is best shown by the fact that, in the new International Atlas of 1931, the same general groups and sub-groups of cloud-forms are recognized.

It was of course obvious from the first that observers would experience difficulty in deciding how to deal with clouds which departed from the really typical form, and this, together with the fact that certain definite variations of the typical form recurred more or less frequently, acted as an incentive to several workers to develop classifications which were much more elaborate than the international one. When, however, in response to a growing demand, the second edition of the International Atlas appeared in 1910, the original classification remained, with the addition of a note upon the lenticular form sometimes assumed by the intermediate clouds, and with a few additional and new illustrations in the Plates.

The development of aviation during the years of the war and

(100321) 107/27 1,050 11/32 M. & S. *Gp.303*

those immediately succeeding it stimulated powerfully the study of cloud formation and development, and many books and atlases dealing with clouds were published in the various countries. In 1922 the International Commission for the Study of Clouds began the preparation of an ambitious new atlas, of which the volume under review is an abridged summary intended specially for the use of observers.

Let it be said at once that this new "International Atlas of Clouds and of States of the Sky" is a worthy consummation of the many years' labour of the Commission, and a remarkable advance upon the earlier atlas. The first part of the text deals with the classification of the individual cloud forms and enumerates practically the same groups as did the original atlas, but gives much more complete descriptive notes of each cloud type and its variations. Following the first part is a second one explaining the "cloud-code" now used internationally by the various official meteorological services. This cloud-code is largely the outcome of that important work, "Les systèmes nuageux," by MM. Schereschewsky and Wehrlé, and enables the observer not only to indicate the individual cloud forms present, but also to describe their general arrangement and organization in the sky, and to indicate the particular stage of their evolution. In practice this code has proved a marked advance upon the older method of merely enumerating the individual cloud forms, though even yet skies are occasionally met with which are not easily assignable to a particular sub-division except by a skilled observer or by a close watch being kept upon the development of the clouds over a period of time. These various "states of the sky," as they are called, can generally be associated with certain definite areas within or surrounding a typical depression.

With regard to the general classification of the clouds, the only type which has been subjected to radical change is nimbus. In the earlier atlas nimbus was regarded as a separate type associated with rain, but in the new atlas precipitation may fall from alto-stratus precipitans or from nimbo-stratus, while the term nimbus is reserved for a ragged scud cloud which forms below the nimbo-stratus. There is still some divergence of opinion regarding this type of cloud, and in the cloud-code the term nimbus is meantime reserved for the broken or ragged low cloud of bad weather.

A word now as to the plates accompanying the text. The atlas of 1910 contained 29 illustrations on 14 plates, but these differed only slightly from those of the 1895 edition. At that time photographic plates had the limitation of being sensitive only to the blue-violet and ultra-violet rays of the spectrum, and it was exceedingly difficult to obtain sufficient contrast between blue sky and white cloud in the case of the higher cirriform clouds. For some cloud types, owing to the lack of suitable photographs, recourse had to be made to water-colour sketches to provide the necessary illustrations.

In the early years of the present century the technique of cloud photography was greatly improved by the ingenious use of a polarising black mirror by A. W. Clayden, and the writer is still inclined to regard Clayden's picture of a waved alto-cumulus as one of the finest ever produced. But with the advent of the panchromatic plate, sensitive to all the spectral colours, and by the employment of yellow, orange, or red filters to give any desired degree of contrast, cloud photographs to-day are far superior to their antecedents of 36 years ago, and the plates in the new atlas demonstrate this very clearly. There are 41 plates containing 41 figures of cloud types, most of which are printed in two colours, blue and grey, in order to achieve as realistic an appearance as possible. Accompanying each plate there is a diagrammatic outline in black and white, and a descriptive note which explains the cloud details in a very lucid manner. The figures have been chosen so as to be as typical examples as possible, and the wide and universal range of their authorship testifies to the assiduousness of the Committee in their selection.

As compared with those in the earlier atlas the photographs are superior from both the scientific and pictorial points of view, and it will be noticed that the majority of them have been taken within the last decade or so. Nevertheless, two outstanding photographs, Plates 23 and 27, were taken at Potsdam as early as 1900. In the writer's opinion the two finest in the set are Plate 36, of tufted cirrus, by Capt. Cave, who has kindly supplied a copy for reproduction as the frontispiece for this number of the magazine, and Plate 3, of turbulent cumulus, from the Office National Météorologique de Paris; the former in particular being a perfect rendering of the delicacy of cirrus structure. Mention should also be made of the very interesting Plate 8, by the Fundació Concepció Rabell of Barcelona, showing by six consecutive photographs the development of bands of strato-cumulus from cumulo-nimbus.

If a note of criticism should be sounded upon so beautiful and valuable a collection of photographs it seems to the writer that Plate 33, representing delicate cirrus, is not so convincing as it might be, but that may be accounted for by its early date—1898. Then again, Plate 7, produced in colours, is certainly very beautiful to look at, but is it quite correct in a scientific work for red and orange colours to appear on the clouds and in the sky while the sun is obviously still 5 to 10 degrees above the horizon?

There are a few obvious printer's errors in the text, and in the second line of the text accompanying Plate 14, "corrugated sheet of cumulo-nimbus" should of course read "corrugated sheet of strato-cumulus."

Such a sumptuous volume has naturally cost a great deal to produce, and it is thanks only to the generosity of M. Rafel

Patxot of Barcelona that the new atlas is obtainable for the relatively very low cost of 14s. 6d. post free.* No meteorologist or person interested in meteorology or clouds should be without it.

G. AUBOURNE CLARKE.

A Katabatic Wind at Heliopolis, Egypt

In the article, "Pressure, temperature and wind variations Heliopolis associated with the warm and cold sectors of a depression," published in the *Meteorological Magazine* for April, 1928, Mr. Durward states "this cooler air lay over the cultivated area around the Nile where the night temperature would naturally be lower." It has been suggested that the use of the word "naturally" may be a little out of place, for it is probably true to say that at first sight an open dry desert site might be expected to record lower minimum temperatures than a site in a cultivated area. Two quotations may be made :—

TABLE I.—NORMALS OF MINIMUM TEMPERATURE IN THE SCREEN.

	Heliopolis (1908-1920) (old site) °C	Giza (1908-1920) °C	Heliopolis-Giza °C
January	7·5	5·5	2·0
February	8·3	6·3	2·0
March	10·9	8·3	2·6
April	13·7	11·5	2·2
May	16·7	14·4	2·3
June	19·4	17·5	1·9
July	21·0	19·4	1·6
August	21·4	19·8	1·6
September	19·4	17·7	1·7
October	17·1	15·7	1·4
November	13·5	11·9	1·6
December	9·4	7·7	1·7
Year	14·9°C	13·0°C	1·9°C

(1) "The Climate of the Continents," Kendrew, p. 25. "But the clear dry air also favours rapid loss of heat from the bare ground after sunset and the cool nights (in the Sahara) are delightfully refreshing."

(2) "Meteorological Atlas of Egypt," plate 9. "To such an extent does the desert lose heat by nocturnal radiation that the night temperature in January on the Mediterranean coast of Egypt is higher than that of all inland stations north of latitude 19°N."

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*A limited number of copies at this price is available at the Royal Meteorological Society, 49, Cromwell Road, London S.W.7.

There can be little doubt but that on calm clear nights the desert commences to cool more rapidly than the Delta region. It is, however, equally apparent from statistics that the actual minima (both screen and ground) registered at Heliopolis, which is just within the desert, are decidedly higher than those registered at non-desert stations. Table I shows normal monthly minimum temperatures at Heliopolis and Giza, a suburb of Cairo on the west bank of the Nile. The level of Giza is 21m. lower than Heliopolis.

The lower readings obtained at Giza and other stations near the Nile in and around Cairo may be ascribed in part to lighter winds in the valley as opposed to the more open desert, but probably chiefly to a drainage effect, the chilled air subsiding during the clear nights from the Mokattam Hills, which rise to a height of over 200 metres within 10Km. east-south-east of Cairo.

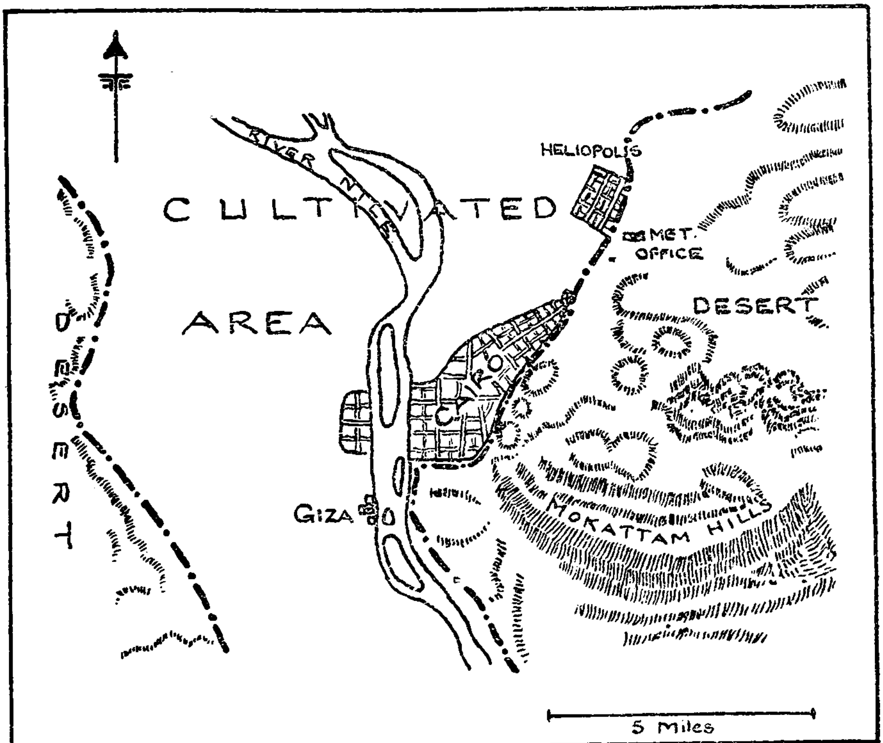


FIG. 1. SKETCH MAP SHOWING POSITION OF METEOROLOGICAL OFFICE AT HELIOPOLIS IN RELATION TO THE DESERT AND CULTIVATED AREAS.

The position of the present meteorological station at Heliopolis is shown in the sketch map (fig. 1). It is definitely within the desert region but near enough to the non-desert region to be influenced by both. On many occasions a prevailing northerly wind at night (this is to some extent, in the early part of the night, a sea breeze which has travelled over 100 miles from the Egyptian coast) is interrupted suddenly and a breeze of about 10-15m.p.h. sets in from a south-easterly point. This breeze has come over open desert and from its low factor of gustiness is easily identified as a katabatic wind. Its characteristics are almost identical with the wind, described by Newnham in the *Meteorological Office Professional Notes* No. 2, which occurs at Benson, Oxon. It descends a matter of 200 metres in 14Km., its arrival at Heliopolis being marked by a rise of temperature of 2° to 3°F. on the average. Some recent typical anemograms and thermograms which show the effect are reproduced in fig. 2. Hygrograms are not reproduced, but the drop in relative humidity which occurs with the setting in of the katabatic wind amounts to 20 per cent. on many occasions.

The ground to the south-east of Heliopolis rises about 1 in 50, whilst the fall to north-west is only about 1 in 150, so that the rate of flow of air from the higher desert after passing Heliopolis is probably, at no great distance away, reduced so much that the thermal cooling by loss of heat to the slope is greater than the dynamical warming (*see* Shaw's "Manual of Meteorology," Vol. IV, p. 227).

The katabatic breeze is not often experienced for more than 1 to 3 hours. Frequently it continues until about 1½ hours after sunrise, by which time the desert has become rapidly warmed and a reversal of wind direction takes place, the normal march of diurnal temperature being interrupted by a fall of 2-3°F. (D in fig. 2.)

Three cases seem to arise :—

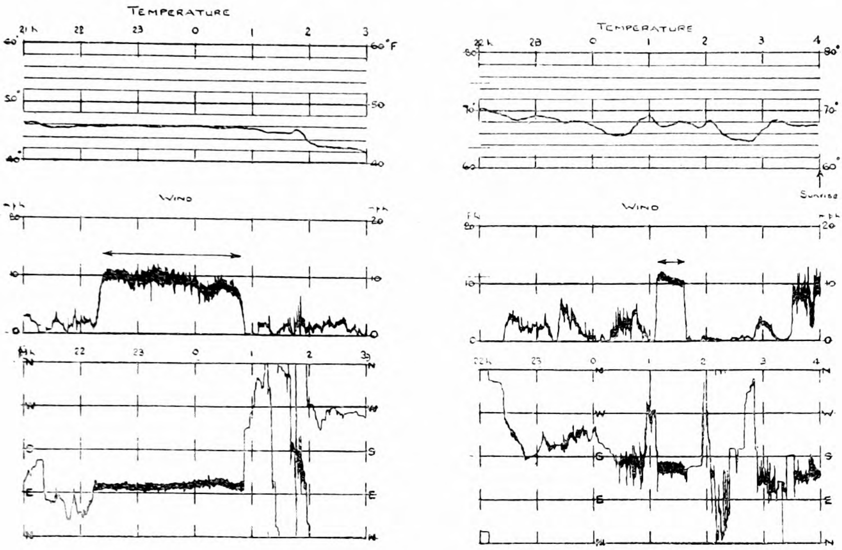
(1) It is probable that the dynamically warmed descending air generally starts to be lifted from the surface at a point a short distance north-west of Heliopolis and passes over the cultivated area at a height varying up to some hundreds of feet, accentuating the normal early morning inversion, the existence of which, over Cairo, is made apparent on most mornings by smoke traces from factory chimneys and by a well-marked haze layer.

(2) Cases also occur where the desert wind seems to be lifted above the surface before reaching Heliopolis. For instance, a pilot balloon ascent made at 4h. G.M.T. on August 12th, 1931, at Heliopolis gave the following results :—

	Wind.	
0-1,000ft.	323°	5m.p.h.
1,000-1,500ft.	125°	2m.p.h.
1,500-2,500ft.	23°	6m.p.h.

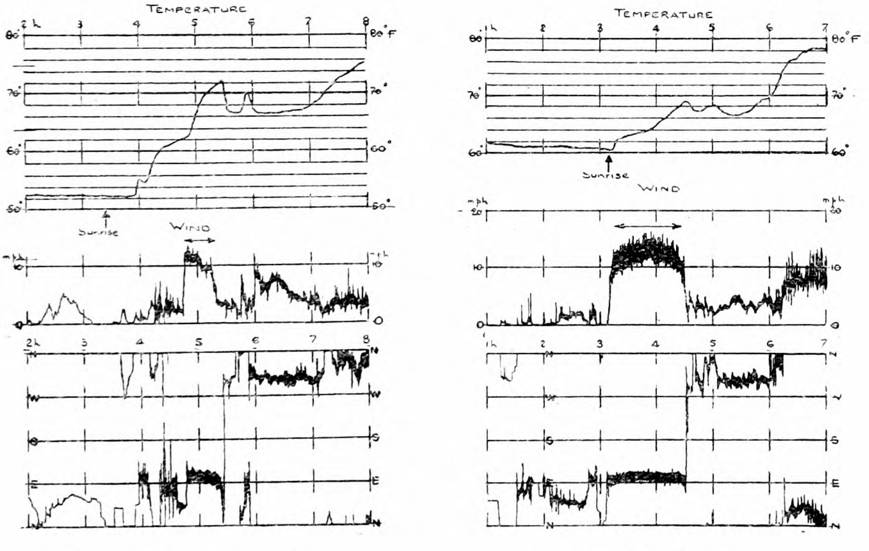
In association with the gliding surface thus formed, low cloud and later fog occurred from 4h. 10m. to 5h. 15m. G.M.T. The surface wind throughout was NW. 2-7m.p.h. from 3h. 30m. to 6h. G.M.T.

(3) In certain circumstances it would appear that the point where the lifting starts may be shifted repeatedly in the immediate neighbourhood of Heliopolis so that the meteorological station comes under the influence of different air masses several



A. 11th February 1932

B. 21st March 1932



C. 18th April 1932.

D. 4th May 1932.

Fig. 2. Wind and temperature records showing katabatic wind effects.

times in the early morning; the drop in temperature which results from the cessation of the katabatic wind may amount to as much as 5°F. Illustrations of this occurred an March 21st and April 18th, 1932; autographic records for these dates are reproduced in fig. 2 (B and C).

In conclusion, it may be remarked that in Table I the differences Heliopolis-Giza are greatest in those months when the normal northerly gradient is most frequently disturbed by Mediterranean depressions. The probable reason for this is that during the remaining months the katabatic wind at Heliopolis is able to assert itself less frequently.

Acknowledgements are due to Mr. Durward for some suggestions which have been incorporated in this note.

C. V. Ockenden.

Meteorological Office War Memorial

At the end of the Great War there was placed in the Library of the Meteorological Office, South Kensington, a temporary memorial to the four members of the staff who lost their lives during the hostilities. This temporary memorial has now been replaced by a bronze plaque bearing the following inscription in white lettering:—

METEOROLOGICAL OFFICE

ROLL OF HONOUR

GREAT WAR

1914-18

G. J. BARKER	London Regt.
N. C. BRADNOCK	London Regt.
W. B. GREENING	R.N.V.R.
E. T. STREETS	London Regt.

The tablet was placed in position shortly before Armistice Day, November 11th, 1932, and on that day it was unveiled by Lt.-Col. E. Gold, D.S.O., Commandant of the Meteorological Section of the Royal Engineers in France during the war. Before unveiling the Tablet, Col. Gold said:—

"This day is naturally a day of great joy—solemn joy—for all who experienced the great strain of the years 1914-1918: and to-day we have met in this library to commemorate especially the sacrifice which four men of the Meteorological Office made. It is right and fitting that we should: the world can never forget what they did. Life is a precious thing to men, but to none is it more precious than to the young—to the men who have just reached the age when they feel the freedom and the power of manhood. These men whom we commemorate to-day were such young men:—

N. C. Bradnock, killed near Ypres, May, 1915, Age 20.
G. J. Barker, killed by a shell in France, October, 1916, Age 19.
W. B. Greening, killed in a night attack at the Dardanelles, May, 1915, Age 18.
E. T. Streets, killed April, 1917, Age 20.

One of them, when I heard in France that he was in the Army—I asked for his transfer to the Meteorological Section—but it was too late—already he had fought and died. Perhaps, though we thought not, it was better so. You remember Socrates' words after his trial: 'whether life or death is better is known to God and to God only.'

"If we reflect, we may find many reasons for their death; they died for the establishment of right and justice among men, and we may gladly remember how much has already been achieved, without minimising how much there is still to do—there will always be to do—no generation can keep peace by the efforts of the past.

"And now, if I can trust myself, I should like to read you some lines in which Homer describes how the Gods desire us to deal with the heroic dead. Jove speaks to Apollo:—

'From amid the spears
Withdraw Sarpedon, and from all his wounds
Cleanse the dark gore; then bear him far away,
And lave his body in the flowing stream;
Then with divine ambrosia all his limbs
Anointing, clothe him in immortal robes.
To two swift bearers give him then in charge,
To Sleep and Death, twin brothers, in their arms
To bear him safe to Lycia's wide-spread plains:
There shall his brethren and his friends perform
His fun'ral rites, and mound and column raise,
The fitting tribute to the mighty dead.'

"I unveil now this Tablet, a memorial to the four men whose names are inscribed upon it."

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings are :—

November 28th, 1932.—*Solar radiation as a meteorological factor.* By H. H. Kimball (Washington D.C., U.S. Dept. Agric., Mon. Weath. Rev., 59, 1931, pp. 472-9). *Opener*—Mr. H. Garnett, M.Sc.

December 12th, 1932.—*On the geographical distribution of fog in Sweden.* By E. Lindskog (Geogr. Ann., Stockholm, 13, 1931, pp. 1-94). *Opener*—Mr. N. H. Smith, B.Sc.

Correspondence

To the Editor, *The Meteorological Magazine.*

The Colour of Moonlight

Walking down Cockspur Street recently I saw in the window of one of the steamship agencies what purported to be a photograph of a steamer taken in moonlight, but which in reality was an ordinary photograph taken in daylight, but printed on a blue photographic paper. This method of obtaining a moonlight effect is well known ; but for some reason this particular picture made me consider why moonlight is associated with blue. So far as I know, there is no physical reason : moonlight is only reflected sunlight and I do not see why the moon's surface should reflect more in the blue than in the other regions of the spectrum ; and no change takes place in the selective absorption of the atmosphere at sundown. I pondered whether the effect was not a convention which does not agree with reality and decided to examine the effect on some suitable night with bright moonlight.

On opening *The Times* the next morning I saw the following letter from Mr. L. C. W. Bonacina :—

" Blue Sky in Moonlight.—Although the night sky, when lit by the full moon after twilight has ended, is usually without colour, it is occasionally conspicuously blue, cases generally occurring with a strong west wind from the Atlantic. On the late evening of Monday, October 17th, an exquisite tint of blue sky, white banks of rippled cloud with a pearly lustre drifting at intervals across the nearly full moon, and a soft, yet invigorating, westerly wind charged with rich autumnal scents, combined to give a night of rare atmospheric beauty in the neighbourhood of London."

This seems to leave no doubt that moonlight scenes do sometimes appear blue. Can anyone say why?

G. C. SIMPSON.

October 24th, 1932.

Unusual Cloud Formation

With reference to the "Unusual Cloud Formation" described by T. F. Prosser in the September number of this magazine (p. 185), I would suggest that the clouds may be of the "horseshoe" type obtained in 1928 in the Imperial College in vertically unstable liquids with a uniform slow shear and recently also in air.

From the form of the cloud our air experiments would indicate that the direction of motion is towards the left-hand bottom corner of the diagrams, and as the picture is towards the south this would probably mean that the motion was roughly towards the south-eastern horizon. On the few occasions when I have seen such clouds there have been many of them, and they have been more circular in form; but unless they are near the zenith perspective would elongate them.

G. T. WALKER.

Imperial College of Science, London, S.W.7. *October 12th,* 1932.

Supplementary Tangent Arcs to the 22° Halo

With reference to the extraordinary tangent arcs to the 22° halo seen on May 10th, 1932, at Padstow, I agree entirely with the opinion expressed by Miss Cicely M. Botley in the October number of the *Meteorological Magazine.*

These arcs cannot be Parry arcs. Yet I do not see why they should be called Kalmar arcs, since well before Kalmar, the observer at Ben Nevis observed the upper arc. Moreover, he was not the first. In the Memoir on halos by Bravais (*Journal de l'école royale polytechnique,* 31è cahier, Paris, 1847) there are given two previous observations of this arc: the one of April 22nd, 1846, by Coulvier (Pl. IV, fig. 148) is remarkably like that seen at Padstow; the other, of March 27th, 1826, by Hansteen (Pl. IV, fig. 140) is no less similar to that seen at Ben Nevis.

Bravais has suggested two explanations of these arcs. According to conditions they would be a reflexion phenomenon produced by the brilliant summit of the halo as the parhelic circle is produced by the sun, or else they would be due to refraction in prisms made by a vertical face and an oblique one sloped at a suitable angle.

These explanations do not seem satisfactory to me. They lack generality even if only the upper and lower tangent arcs are considered. Now, on different occasions other arcs tangent to the 45° halo have been seen on about the horizontal or again laterally at the height of the illuminating body.

The impression obtained is that this is a question of connected phenomena due to a similar method of dispersion of light, but it appears difficult to imagine such an example bringing in only the forms of ice crystals actually observed.

L. BESSON.

Solar Phenomena

On October 10th I observed the following phenomena at 12h. 30m. G.M.T. The phenomena consisted of the upper portion of the 22° halo, with the upper contact arc curved downwards. The junction of the two arcs was bright. A parhelion occurred on either side of the sun, that on the right having a portion of the parhelic circle extending from it. The most interesting feature, however, was a short straight band of coloured light at the lower right-hand portion of the system and situated a few degrees outside the 22° halo. There were only two colours discernable which were very distinct, namely, red and green, the red being inside or towards the sun. Probably it was a portion of the lower arc of contact corresponding with the upper circumscribed arc. The upper portion of the 22° halo was observed at intervals during most of the morning. Weather conditions were unsettled with cumulo-nimbus and anvil cirrus round the southern horizon. The above phenomena were observed in bands of cirrus and cirro-stratus extending from small broken anvil-shaped clouds in the south-west. Rain appeared to be falling from the base of the anvils out to sea during most of the morning, while distant thunder and lightning occurred in the same direction, viz., from the south-east to the south-west, early (12h. to 2h.) when well developed anvils of "false cirrus" were visible on the horizon.

A. E. MOON.

39, *Clive Avenue, Clive Vale, Hastings. October* 11*th*, 1932.

A Series of Rainbows

As a result of the rapid succession of storm and sunshine, rainbows were seen here on at least seven occasions between 7 a.m. and 4.30 p.m. on October 13th. I myself saw the rainbows on five of these occasions. I cannot recall witnessing such a series previously, say, since 1862. The rainfall here was 0.84in. on the 13th, but the full inch was measured in the village which is within ⅔ mile.

J. EDMUND CLARK.

Portway, Street, Somerset. November 1*st*, 1932.

NOTES AND QUERIES

The New International Weather Chart of the Northern Hemisphere

One of the aims of the Second International Polar Year is the detailed synoptic study of the atmospheric circulation over as large an area as possible. To aid in this research, the Deutsche Seewarte, Hamburg, undertook, on behalf of the International

Meteorological Organisation, to prepare a series of daily weather charts of the whole of the northern hemisphere. The preparatory work on these charts began at the end of 1930 and has been so successful that their production in time for discussion with the results of the Polar Year 1932-3 is fully assured, provided the necessary funds are forthcoming.

Two basic charts were prepared, a large chart on a scale of 1 to 30 million, in two colours, with a network of co-ordinates for every degree of latitude and longitude, showing also the river systems and the contour lines, and a smaller chart in one colour on a scale of 1 to 60 million. A number of sample weather charts were drawn for March, 1931, using different methods of representation, from which useful experience was gained in the collection of the data and the cost of preparation. The most suitable hour of observation was found to be about Greenwich noon, and the various Meteorological Services are supplying the corrected data for a selection of their stations in code form on manuscript sheets.

Up-to-date daily weather charts covering a large part of the northern hemisphere are no novelty, the first series having been made by the U.S. Weather Bureau at Washington as early as 1914, and similar charts made possible by the extensive organisation of reports by wireless telegraphy have been regularly issued for some time, by the Meteorological Office, London, and the Deutsche Seewarte, Hamburg. These up-to-date charts unavoidably show large blank areas, especially in low latitudes, but these blanks will be avoided in the new series, which will be based on far more complete series of data. In particular, the ocean areas will be represented to an extent not possible in the existing charts. Thanks to the willingness shown by all countries to co-operate, it should be possible to publish daily charts containing observations from about 1,000 land stations and 500 ships, all with a large number of weather elements.

Specimen charts for the first seven days of March, 1931, have already been published, and are of great interest. The charts for March 1st-4th and 6th give the isobars at intervals of 5mb., and also, for each station, the total cloudiness, wind direction and force, air temperature (for ships also sea temperature) and weather. The chart for March 5th gives isobars at intervals of 10mb., and in addition to the above details, the types of different clouds, the barometer reading, and at land stations the nature and amount of the barometric change in the preceding three hours. The chart for March 7th gives even more information along the lines of the Norwegian scheme of symbols. The specimens are completed by four charts on the half-scale maps. The final choice will be made according to the preferences shown by the recipients of the sample charts, but the publication of the series for the whole period of the Polar Year, from

August 1st, 1932, to August 31st, 1933, depends on the possibility of raising the necessary funds. The cost of publication must be covered by the sale of the charts, and the price of each set depends on the number of subscribers. With 400 subscribers the cost of the complete series of large charts giving full detail, similar to the specimen chart for March 7th, would be 171 RM., including portfolios. The cost of the simpler charts would be proportionately less, ranging down to 56 RM. for a complete series of small scale charts giving data for a limited number of stations. In order to obtain an idea of the number of purchasers, it is important that those meteorologists who are interested should indicate their readiness to subscribe. The assurance that the scheme will not have to be abandoned on the ground of cost will encourage Meteorological Services in undertaking the heavy task of condensing and coding the observations from a number of stations. The Deutsche Seewarte, Hamburg, will gladly send sample weather charts and price lists to those interested. Should the enterprise attain sufficient measure of success, it is hoped to continue the preparation of the charts after the end of the Polar Year, and a long series of daily charts of this degree of completeness will form an invaluable basis for many important researches.

Meteorological Station established at Bermuda

On August 5th, 1932, His Excellency the Governor, Lieut.-General Sir T. Astley-Cubitt, K.C.B., C.M.G., D.S.O., officially opened the new station, stating that it cannot fail to be classed as one of the most important meteorological centres of the British Empire, and that it had been established at considerable cost to the Colony for the benefit, not only of Bermuda, but also of the whole world.

The station is situated at Fort George on the crest of a hill 150 feet above sea level, and has a free exposure on all sides. The top of the fort provides an excellent position for taking pilot balloon observations, the first floor provides four offices and there is ample space on the second floor for storage of records.

It is principally due to the kind co-operation of the Meteorological Services of Great Britain, Canada and the United States that this office has been able to commence work so quickly, and it is now in a position to issue daily forecasts as well as broadcast warnings of tropical disturbances in the vicinity dangerous to shipping.

A meteorological station was established at St. George's, Bermuda, as early as January, 1866, the observations being made by the Army Medical Department. In December, 1869, the Medical Department was transferred to Hamilton and observations recommenced at the latter station in April, 1870. In

1901 the name of the Station was changed to Prospect, but there was no change of site until the opening of the new station.

Unification of the Meteorological Services of Portugal

A decree of the Ministry of Public Instruction and Fine Arts in Lisbon unifies the meteorological services of Portugal under the Central Meteorological Observatory annexed to the Faculty of Sciences of Lisbon with the collaboration of the other existing Meteorological Services and Observatories in Portugal, the Azores and Madeira. A national system of climatological stations is constituted, to make observations with standardised instruments according to a uniform plan. The principal hours of observation will be 9h. and 15h., but autographic instruments will be installed at as many stations as possible.

" Rain in Places "

The Meteorological Office was asked recently to furnish an answer to the following question: " On what percentage of days throughout the year does rain fall to the amount of 1mm. or more somewhere in the British Isles? " The question could not be answered from published statistics, which relate only to the frequency of such days at individual stations. Days with a fall of 1mm. (.04 inch) or more are referred to in *British Rainfall* as " wet days " and their average percentage frequency varies from about 30 at dry inland stations to 50 or more at wet stations in Scotland and Ireland. Knowing that it is rare for the weather to be rainless for 24 hours over the whole of the British Isles simultaneously, we should naturally expect the frequency of days which are " wet days " somewhere or other within the area to exceed by a large margin the frequency of " wet days " at any individual station.

In order to furnish an approximate answer to the question, a year, 1925, was selected in which the frequency of wet days was nearly normal in each of the main divisions of the British Isles and it was decided to confine attention to the 43 well-distributed stations for which daily readings of rainfall for the period of 24 hours ending at 7h. G.M.T. are given in the *Daily Weather Report, British Section.* The reports for the whole year were examined and it was found that on all but 12 days a rainfall of 1mm. or above occurred at one or more of the stations. Two of the days occurred in March, one in April, seven in June and two in November. The June of 1925 was exceptionally dry and this fact may have affected the total frequency of " non-wet " days for the year. Also some of the days on which no reading of 1mm. occurred would probably have disappeared from the list had the records of additional stations in wet areas been examined.

Taking the figures as they stand, however, it appears that about 97 per cent. of all days yield a rainfall of at least a millimetre somewhere within the confines of the British Isles.

In a note on " The Daily Fall of Rain over the British Isles " in the *Quarterly Journal of the Royal Meteorological Society*, 1927, pp. 65-7, Dr. J. Glasspoole gives data which are of interest in this connexion. Taking a hundred well-distributed stations he found that in the wet year 1923 there was not a single day without rain at one station at least, and there were only four days without rain at fewer than five stations.

E. G. BILHAM.

Dust Haze at Wei Hai Wei

A report has recently been received from Flight-Lieut. R. M. Trevethan, M.C., R.A.F., of an unusually intense dust haze at Wei Hai Wei on May 19th, 1932.

During the morning there was a gusty south-westerly wind of force 4 at sea level with a visibility of 4 to 5 miles away from the sun and ¾ to 1 mile into the sun. In the evening there was a calm and the visibility decreased as the wind dropped. During an aeroplane ascent in a cloudless sky at 11h. 15m. local time, the temperature rose from 70°F. at the ground to 73°F. at 2,000 feet, while there was a lapse rate exceeding the dry adiabatic from 4,000 to 8,000 feet. The visibility at 8,000 feet was similar to that at ground level and the haze thinner, while it was estimated the haze top was about 10,000 feet. The weather maps for May 19th disclosed a low-pressure area extending from east Mongolia southwards to the province of Anhwei, with the lowest pressure near to and north-east of Pekin. Other shallow depressions were shown east of Shanghai and near eastern Korea. Pressure was relatively high towards the Burmese borderlands. This pressure distribution gave rise to an average air movement from north-west to west near Wei Hai Wei and the air mass most probably originated over Inner Mongolia and the Gobi Desert. The dust deposit was so thick that sweepings were made from the wings of the seaplane, which was on deck after the ascent. The dust was dark brown in colour and the particles extremely small.

Lieut. J. P. Wright, R.N., in a report, dated October 26th, 1929, states that dust haze extends to considerable heights and occasionally to 10,000 feet over land areas near the south China coast during nearly the whole of the north-east monsoon and occasionally at other times. It is especially thick when the sky is cloudless and turbulence over the land assists. In north China it is fairly common in fine weather, but it is less regular in its occurrence; it does not extend to such high levels, and the horizon above the haze is not so clear cut. The clear-cut horizon is always accompanied by a temperature inversion or a noticeable temporary decrease of lapse rate.

Lieut.-Com. Doddington, R.N., in commenting on Lieut. Wright's report, considers that during the north-east monsoon the haze top marks the boundary of the monsoon wind and the counter westerly wind above. The haze is more pronounced near the land, but it probably exists well out to sea. During the southerly monsoon in summer there is no sharp-cut haze horizon and no sharp dividing line between the surface air currents and those above.

The measurements referred to in the early part of this report were taken during the early part of the summer monsoon when SE. winds prevail over east China near the Yangtze, and the decrease in haze at the top of the ascent and its probable termination at 10,000 feet bear out the views expressed in the preceding paragraph.

R. S. Read.

Reviews

Acta Phænologica, Vol. 1, Parts 1-6. Edited by the Board of the Phenological Association of the Netherlands, Secretary, Dr. H. Bos. Size 10 × 6½in., pp. 200 + xii. The Hague, 1931-2. Price 6 guilders for 6 parts.

With the first volume now complete before him the reader is able to form some estimate of the value of the first international phenological journal to be published. Both Dr. Bos of Wageningen, and the Phenological Association of the Netherlands are to be congratulated on the result of their enterprise. Over twenty articles on various phenological subjects contributed from five countries, together with sundry notes and summaries, make up an impressive table of contents for the first volume, and should be encouraging to all concerned. Dr. Hugh Robert Mill once described phenology as "a rather woolly subject," and this "woolliness" is not reduced by the language difficulty, which here is somewhat obtrusive, and, in these Islands at any rate, may tend to make the journal less popular than it deserves to be. This difficulty is anticipated and commented on in the last number in the Volume and would seem to be inherent in the nature of an international journal and scarcely avoidable. With regard to phenology itself, a noteworthy suggestion to reduce the "woolliness" is contained in a paper by Professor S. Illichevsky (p. 177) who proposes a numerical and symbolical method of recording observations which would make for greatly increased precision in the notes with which tabulators have to deal. These would therefore become increasingly valuable, and in process of time would give an accurate view of the effect on wild nature of the march of the seasons, modified by meteorological vagaries, far beyond anything at present available—possibly on a world-wide scale. It is impossible in the limited space at our disposal to give due appreciation to the interesting articles by Dr. Bos, Dr. Ihne and other contributors; those interested are recommended to explore these pages for themselves. The publication of the sixth number, completing Vol. 1, coincides with the 75th birthday of Dr. Bos and forms in itself a fitting testimonial to a distinguished career, which it may be hoped is by no means finished. The President of the Phenological Association of the Netherlands, in his note on p. 161, draws attention to the venerable ages of the leading phenologists, viz., Dr. Ihne 73, Dr. Bos 75, and Mr. J. E. Clark 81. Truly these three gentlemen are to be congratulated on having lived to see their science, always important, at long last universally recognized and organized on international lines.

R. MARSHALL.

Die Verwendungsmöglichkeit der Relationen zwischen Trübungsfaktoren und Luftkörpern für die praktische Wetteranalyse. By W. Grundmann and O. Moese. (Reprint from Ann. Hydr. Berlin 59, 1931, pp. 254-61.)

From the examination of observations of solar radiation made in June, 1930, it is shown that these observations are of help in identifying air masses. The absorption of radiation by the atmosphere is larger in tropical air than in polar air, owing to its greater water content. In interpreting the data, allowance must be made for local factors such as town smoke.

C. K. M. DOUGLAS.

Obituary

Father Louis Froc, S.J.—We regret to learn of the death in October in Paris of Father Froc, Director of Zi-ka-wei Observatory, Shanghai, from 1896 to 1931. Father Froc was born in Brest in 1859. He entered the Society of Jesus at the age of 16 and studied for the priesthood. In 1883, though not yet a priest, he went to take up work with the Kiangnan Mission at Zi-ka-wei, then a small meteorological observatory. In 1896 he became the Director of this observatory and devoted himself to the study of typhoons to the great benefit of the world's shipping. He organised the system of daily weather reports and typhoon warnings issued by the observatory, and when he retired, the observatory was one of the most important ones in the East. A short account of his works is given in the *Meteorological Magazine* for March, 1932, p. 41.

Father Ricardo Cirera, S.J.—We regret to learn of the death on November 3rd of Father R. Cirera, founder and Director of the Observatory of the Ebro. Father Cirera was born in 1864 and first showed his scientific abilities in the magnetic section of

Manila Observatory, afterwards studying in the great observatories of Europe and America. In 1904 he realised his life's ambition of establishing a geophysical observatory in Spain, the well-known Observatorio del Ebro, Tortosa, of which he became the first Director, retiring in 1919.

News in Brief

Dr. G. C. Simpson, C.B., F.R.S., Director of the Meteorological Office, has been elected a corresponding member of the State Russian Geographical Society.

Father J. de Moidrey, S.J., retired from the directorship of the magnetic section of the Zi-ka-wei Observatory in April, 1932. He is succeeded by Father M. Burgaud, S.J. Father de Moidrey during the last fourteen years published a number of studies dealing with different aspects of terrestrial magnetism based chiefly on the work of the magnetic observatory at Lu-kia-pang.

The Weather of October, 1932

Pressure was below normal over Europe (except the Iberian Peninsula), Iceland, Spitsbergen, northern Alaska, eastern Canada, eastern and south-western United States, the greatest deficit being 11.3mb. at Blaavands Huk. In Scania, Sweden, it was 9.5mb. below normal, the greatest deficit recorded there in October for at least 70 years. Pressure was above normal over the North Atlantic, southern Greenland, western Canada and north-western United States, the greatest excesses being 6.7mb. at Horta and 4.1mb. at 60°N. 110°W. Temperature was below normal generally in northern and south-west Europe but above normal in central Europe and Spitsbergen. Precipitation was deficient in Spitsbergen and central Europe. In Sweden, it was only 40 per cent. of the normal in western Lapland, increasing to 115 per cent. in eastern Norrland, to 140 per cent. in Dalecarlia and to twice the normal in south-eastern Gothaland.

Unsettled wet weather prevailed during most of October over the British Isles, though much sunshine occurred early in the month in the south and Midlands. On the 1st there was a gradual drop of temperature as northerly winds penetrated southwards in the rear of a depression which was moving away eastwards. This was followed by an anticyclone spreading across from the North Atlantic to central Europe. Fine sunny cool weather prevailed generally during the next few days except after the 3rd in north Scotland; 10.0hrs. bright sunshine were reported from Clacton, Dover, Portsmouth and Southsea on the 4th and ground frosts occurred in many places; 18°F. and 19°F.

were recorded at Renfrew and Rhayader respectively on the 4th. Snow was reported on the hills above Fort Augustus on the 5th. By the 6th a deep depression centred south-east of Iceland was spreading south-east, temperature was rising considerably and rain falling generally in the north-west. From the 7th to the 17th a complex area of low pressure lay over the British Isles, rain occurred on most days, the heaviest falls being on the 7th and 11th, 2.71in. were recorded at Trecastle (Brecon) and 2.08in. at Holne (Devon) on the 7th, and 3.05in. at Pembroke on the 11th. The 9th was the sunniest day of the period in Scotland and the 10th in England and Ireland, with 9.0hrs. bright sunshine at Inchkeith on the 9th and 9.8hrs. at Plymouth and 9.5hrs. at Ballinacurra on the 10th. Thunderstorms occurred in south-east England on the 11th and in the Midlands on the 13th while strong winds and gales were experienced at the mouth of the English Channel and in north Scotland and north Ireland on the 7th and 8th and locally in the north on the 14th. After the strong north-westerly gales early in the morning of the 18th had subsided a wedge of high pressure passed across the country, giving a sunny period with 9.3hrs. sunshine at Dover and 9.1hrs. at Bradford, Folkestone and Hastings on the 18th. From then to the end of the month a series of depressions moved across the country, sometimes north-eastwards, sometimes south-eastwards. Weather was generally unsettled with heavy rain at times but some bright intervals, 3.18in. of rain were measured at Snowdon (Carnarvon) and 3.07in. at Trecastle (Brecon) on the 21st. The 28th was the sunniest day of the period, with 9.0hrs. at Torquay and Bognor, 8.6hrs. at Ballinacurra and 8.4hrs. at Dumfries. Temperature was low in Scotland during this time and also in England on the 28th and 29th. The maximum temperature at Marchmont and Durham on the 29th was only 37°F., while a screen minimum of 24°F. was recorded at Renfrew and minima on the ground of 16°F. at Renfrew and 17°F. at Rhayader and Dalwhinnie. Snow showers were reported from Aberdeen on the 28th and snow fell locally in Scotland on the 29th. Thunderstorms occurred locally in Ireland on the 22nd and 27th while gales were experienced at the month of the English Channel on the 22nd, 23rd and 27th and on the western seaboard on the 29th, 30th. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	56	—30	Liverpool	81	— 5
Aberdeen	81	—14	Ross-on-Wye	108	+16
Dublin	126	+22	Falmouth	121	+ 5
Birr Castle	113	+15	Gorleston	71	—38
Valentia	80	—21	Kew	97	+ 5

Miscellaneous notes on weather abroad culled from various sources.

A small hurricane swept over the village of Landenbach (north Wurtemberg) on the night of the 13th. It lasted only a few minutes but did much material damage; no one was hurt. Snow fell on the 28th in Switzerland down to the level of 3,500ft; further abundant snowfalls occurred on the following days, the snow on the 30th being down to the 1,000ft. level. The Alpine passes were blocked by the 31st. Torrential rains during the last few days of the month caused floods in Belgium. The Senne overflowed at Forest (a suburb of Brussels) and the Meuse broke its banks between Namur and Dinant. During the last days of the month also gales were experienced along the Atlantic and English Channel seaboards of France and heavy rain or snow, inland in most districts of France; many rivers were in varying degrees of flood. (*The Times*, October 15th-November 1st.)

A severe thunderstorm which occurred in Palestine on the 5th caused much damage in Rishon-le-Zion and Tel Aviv. (*The Times*, October 7th.)

Much damage was done by a cyclone in the Warworth district of North Auckland (New Zealand) on the 26th. Thunderstorms occurred locally in Queensland during the last days of the month. (*The Times*, October 28th-November 3rd.)

A blizzard was experienced in northern Ontario on the 8th. A cloudburst occurred near Tehachapi Cañon (California) on the 1st; 80 people were drowned in the cañon and 13 other people given up as lost. Much damage was done at Tehachapi, Woodford, Caliente, and other small towns near by in the mountains. Violent storms occurred in the region of Rio de Janeiro about the 5th. Temperature was below normal generally during the first half of the month but later a warm spell passed across the country from west to east. The greatest change took place in the Missouri Valley. Rapid City (South Dakota) and North Platte (Nebraska) were respectively 15°F. and 7°F. below normal for the week ending the 11th, 3°F. and 10°F. above normal for the week ending the 18th and 8°F. and 4°F. below normal for the weeking ending the 25th. Rainfall was mainly about normal except during the middle of the month in the Atlantic coastal regions and the eastern Gulf States. Greenville (South Carolina) had as much as 7.1in. above the normal for the week ending the 18th. (*The Times*, October 3rd-13th and *Washington D.C., U.S. Dept. Agric. Weekly Weather and Crop Bulletin.*)

Rainfall, October, 1932—General Distribution

England and Wales	153	per cent of the average 1881-1915.
Scotland	169	
Ireland	105	
British Isles	148	

Rainfall : October, 1932 : England and Wales.

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Lond .	Camden Square	5·25	199	*Leics* .	Belvoir Castle............	3·02	112
Sur .	Reigate, Alvington ...	6·82	205	*Rut* .	Ridlington	3·32	118
Kent .	Tenterden, Ashenden...	7·32	209	*Lincs* .	Boston, Skirbeck	3·36	123
,, .	Folkestone, Boro. San .	8·89	...	,,	Cranwell Aerodrome ...	3·13	109
,, .	Margate, Cliftonville...	5·10	175	,, .	Skegness, Marine Gdns	2·71	99
,, .	Sevenoaks, Speldhurst	5·91	...	,, .	Louth, Westgate	3·68	114
Sus .	Patching Farm	7·56	191	,, .	Brigg, Wrawby St. ...	2·94	...
,, .	Brighton, Old Steyne..	6·34	164	*Notts* .	Worksop, Hodsock ...	3·08	117
,, .	Heathfield, Barklye ...	8·91	215	*Derby* .	Derby, L. M. & S. Rly.	2·82	108
Hants .	Ventnor, Roy. Nat. Hos.	7·55	192	,, .	Buxton, Devon Hos. ...	8·00	163
,, .	Fordingbridge, Oaklnds	5·35	129	*Ches* .	Runcorn, Weston Pt...	6·26	182
,, .	Ovington Rectory	5·96	147	,, .	Nantwich, Dorfold Hall	5·47	...
,, .	Sherborne St. John ...	4·11	117	*Lancs* .	Manchester, Whit Pk.	6·78	205
Berks .	Wellington College ...	4·45	136	,, .	Stonyhurst College ...	7·91	176
,, .	Newbury, Greenham...	4·54	129	,, .	Southport, Hesketh Pk	7·15	202
Herts .	Welwyn Garden City...	4·12	...	,, .	Lancaster, Strathspey	5·98	...
Bucks .	H. Wycombe, Flackwell	4·76	...	*Yorks* .	Wath-upon-Dearne ...	3·26	118
Oxf .	Oxford, Mag. College...	4·43	159	,, .	Bradford, Lister Pk. ...	4·35	125
Nor .	Pitsford, Sedgebrook...	3·07	114	,, .	Oughtershaw Hall	9·22	...
,, .	Oundle.....................	2·76	...	,, .	Wetherby, Ribston H.	3·24	108
Beds .	Woburn, Crawley Mill	3·43	128	,, .	Hull, Pearson Park ...	2·91	98
Cam .	Cambridge, Bot. Gdns.	3·41	144	,, .	Holme-on-Spalding ...	3·35	...
Essex .	Chelmsford, County Lab	4·90	200	,, .	West Witton, Ivy Ho.	4·26	115
,, .	Lexden Hill House ...	4·96	...	,, .	Felixkirk, Mt. St. John	3·55	123
Suff .	Haughley House.........	3·79	...	,, .	Pickering, Hungate ...	3·85	126
,, .	Campsea Ashe............	4·78	183	,, .	Scarborough	3·10	99
Norf .	Norwich, Eaton.........	...	...	,, .	Middlesbrough	2·91	100
,, .	Wells, Holkham Hall	4·21	150	,, .	Balderdale, Hury Res.	5·29	...
,, .	Swaffham, The Villa...	5·68	192	*Durh* .	Ushaw College	4·63	134
Wilts .	Devizes, Highclere......	5·10	164	*Nor* .	Newcastle, Town Moor	3·50	109
,, .	Bishops Cannings	5·51	166	,, .	Bellingham, Highgreen	4·79	122
Dor .	Evershot, Melbury Ho.	8·17	177	,, .	Lilburn Tower Gdns...	5·42	146
,, .	Creech Grange	6·64	131	*Cumb* .	Geltsdale..................	5·81	...
,, .	Shaftesbury, Abbey Ho.	5·76	148	,, .	Carlisle, Scaleby Hall	5·37	161
Devon .	Plymouth, The Hoe...	7·82	198	,, .	Borrowdale, Seathwaite	19·00	167
,, .	Launceston, Werringt'n	10·94	...	,, .	Borrowdale, Moraine...	16·40	...
,, .	Holne, Church Pk. Cott.	13·29	201	,, .	Keswick, High Hill...	8·43	...
,, .	Cullompton...............	7·48	181	*West* .	Appleby, Castle Bank	5·86	168
,, .	Sidmouth, Sidmount...	6·51	175	*Glam* .	Cardiff, Ely P. Stn. ...	6·64	138
,, .	Filleigh, Castle Hill ...	9·99	...	,, .	Treherbert, Tynywaun	15·72	...
,, .	Barnstaple, N. Dev. Ath	9·25	202	*Carm* .	Carmarthen Friary ...	9·17	160
,, .	Dartm'r, Cranmere Pool	16·70	...	*Pemb* .	Haverfordwest, School	8·07	149
Corn .	Redruth, Trewirgie ...	8·96	171	*Card* .	Aberystwyth	7·67	...
,, .	Penzance, Morrab Gdn.	9·10	195	,, .	Cardigan, County Sch.	7·07	...
,, .	St. Austell, Trevarna...	10·03	190	*Brec* .	Crickhowell, Talymaes	8·50	...
Soms .	Chewton Mendip	8·16	169	*Rad* .	Birm W. W. Tyrmynydd	10·33	156
,, .	Long Ashton	7·48	198	*Mont* .	Lake Vyrnwy...........	9·27	163
,, .	Street, Millfield.........	5·82	178	*Denb* .	Llangynhafal	5·37	142
Glos .	Blockley	4·20	...	*Mer* .	Dolgelly, Bryntirion...	11·00	181
,, .	Cirencester, Gwynfa ...	5·22	158	*Carn* .	Llandudno	3·72	104
Here .	Ross, Birchlea............	5·37	163	,, .	Snowdon, L. Llydaw 9	24·45	...
,, .	Ledbury, Underdown..	4·41	143	*Ang* .	Holyhead, Salt Island	5·24	131
Salop .	Church Stretton.........	5·80	160	,, .	Lligwy.....................	6·46	...
,, .	Shifnal, Hatton Grange	4·45	157	*Isle of Man*			
Worc .	Ombersley, Holt Lock	3·57	134		Douglas, Boro' Cem. ...	8·50	184
War .	Birminghm, Edgbaston	3·55	128	*Guernsey*			
Leics .	Thornton Reservoir ...	4·01	143		St. PeterP't. GrangeRd	6·34	141

Rainfall: October, 1932: Scotland and Ireland.

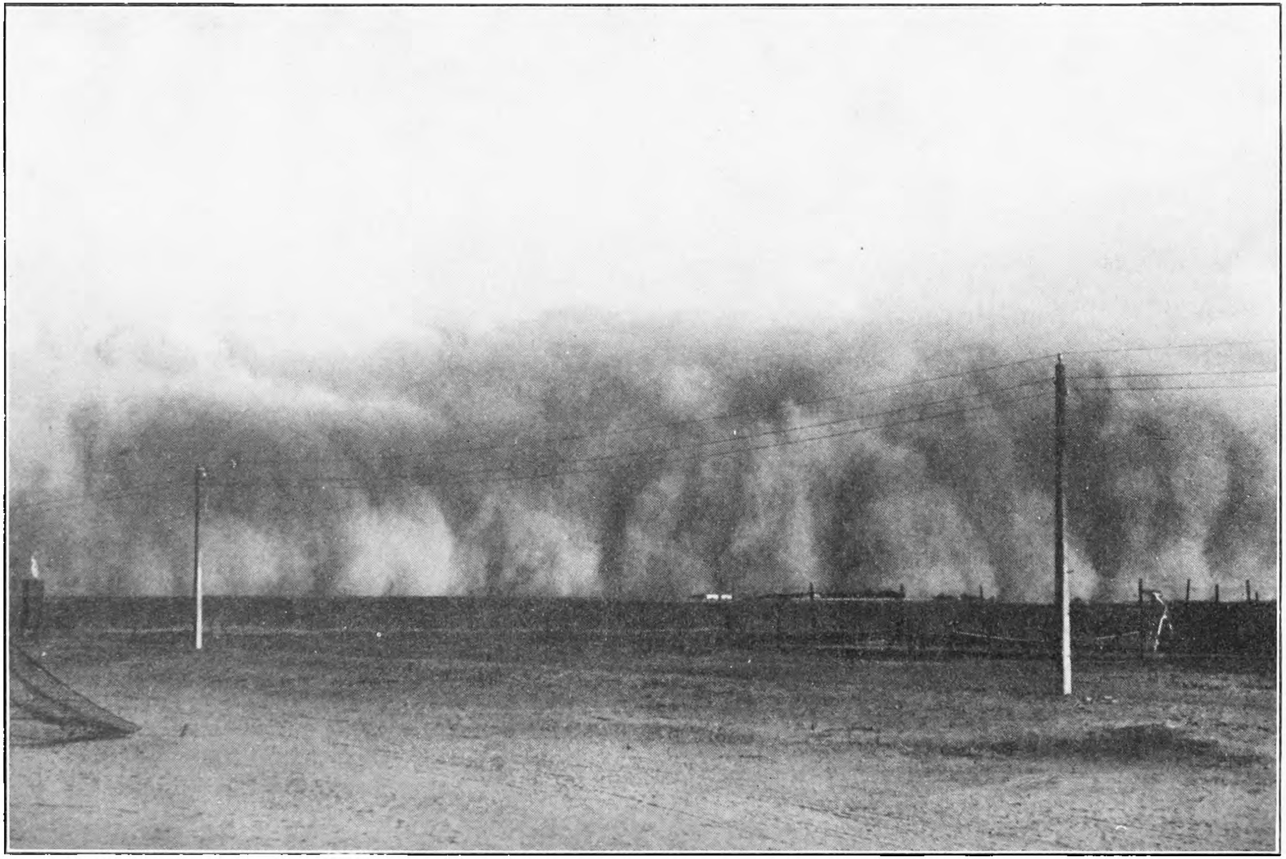
Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt	Pt. William, Monreith	5·91	149	*Suth*	Melvich	4·76	...
,,	New Luce School	7·04	151	,,	Loch More, Achfary	8·32	107
Kirk	Carsphairn, Shiel	11·04	155	*Caith*	Wick	4·93	166
Dumf	Dumfries, Crichton, R.I	6·02	162	*Ork*	Pomona, Deerness	4·56	120
,,	Eskdalemuir Obs.	9·18	170	*Shet*	Lerwick	3·38	86
Roxb	Branxholm	5·40	166	*Cork*	Caheragh Rectory	5·52	...
Selk	Ettrick Manse	7·89	143	,,	Dunmanway Rectory	5·91	98
Peeb	West Linton	6·31	...	,,	Ballinacurra	4·28	105
Berw	Marchmont House	6·05	158	,,	Glanmire, Lota Lo.	4·04	97
E.Lot	North Berwick Res.	5·36	181	*Kerry*	Valentia Obsy	5·19	93
Midl	Edinburgh, Roy. Obs.	5·81	212	,,	Gearahameen	8·40	...
Lan	Auchtyfardle	5·40	...	,,	Killarney Asylum	4·53	84
Ayr	Kilmarnock, Kay Pk.	6·00	...	,,	Darrynane Abbey	4·91	98
,,	Girvan, Pinmore	7·67	153	*Wat*	Waterford, Gortmore	5·03	128
Renf	Glasgow, Queen's Pk.	6·49	199	*Tip*	Nenagh, Cas. Lough	3·72	110
,,	Greenock, Prospect H.	7·45	138	,,	Roscrea, Timoney Park	3·32	...
Bute	Rothesay, Ardencraig.	9·10	...	,,	Cashel, Ballinamona	3·30	92
,,	Dougarie Lodge	6·76	...	*Lim*	Foynes, Coolnanes	3·65	98
Arg	Ardgour House	12·83	...	,,	Castleconnel Rec.	3·92	...
,,	Glen Etive	12·93	160	*Clare*	Inagh, Mount Callan	6·42	...
,,	Oban	9·40	204	,,	Broadford, Hurdlest'n.	4·11	...
,,	Poltalloch	8·67	175	*Wexf*	Gorey, Courtown Ho.	3·62	102
,,	Inveraray Castle	11·98	170	*Kilk*	Kilkenny Castle	3·35	106
,,	Islay, Eallabus	7·40	155	*Wick*	Rathnew, Clonmannon	3·45	...
,,	Mull, Benmore	...	...	*Carl*	Hacketstown Rectory	3·35	88
,,	Tiree	5·13	113	*Leix*	Blandsfort House	3·64	103
Kinr	Loch Leven Sluice	5·97	174	,,	Mountmellick	4·90	...
Perth	Loch Dhu	...	...	*Offaly*	Birr Castle	3·30	113
,,	Balquhidder, Stronvar	6·29	...	*Kild'r*	Monasterevin	3·96	...
,,	Crieff, Strathearn Hyd.	5·87	149	*Dublin*	Dublin, FitzWm. Sq.	2·36	88
,,	Blair Castle Gardens	6·62	213	,,	Balbriggan, Ardgillan.	2·74	101
Angus	Kettins School	6·26	198	*Meath*	Beauparc, St. Cloud	3·29	...
,,	Dundee, E. Necropolis	6·48	243	,,	Kells, Headfort	3·67	110
,,	Pearsie House	6·24	...	*W.M*	Moate, Coolatore	3·36	...
,,	Montrose, Sunnyside	6·83	247	,,	Mullingar, Belvedere	4·29	129
Aber	Braemar, Bank	8·17	217	*Long*	Castle Forbes Gdns.	3·76	115
,,	Logie Coldstone Sch.	7·76	239	*Gal*	Ballynahinch Castle	4·46	75
,,	Aberdeen, King's Coll.	6·59	219	,,	Galway, Grammar Sch.	2·84	...
,,	Fyvie Castle	7·91	207	*Mayo*	Mallaranny	5·87	...
Moray	Gordon Castle	6·54	207	,,	Westport House	4·10	91
,,	Grantown-on-Spey	...	...	,,	Delphi Lodge	6·74	71
Nairn	Nairn	4·59	195	*Sligo*	Markree Obsy	5·37	132
Inv's	Ben Alder Lodge	7·92	...	*Cavan*	Belturbet, Cloverhill	3·24	111
,,	Kingussie, The Birches	6·66	...	*Ferm*	Enniskillen, Portora	3·56	...
,,	Loch Quoich, Loan	15·10	...	*Arm*	Armagh Obsy	2·82	104
,,	Glenquoich	16·72	167	*Down*	Fofanny Reservoir	5·10	...
,,	Inverness, Culduthel R.	4·87	...	,,	Seaforde	3·77	106
,,	Arisaig, Faire-na-Squir	8·98	...	,,	Donaghadee, C. Stn.	3·12	108
,,	Fort William, Glasdrum	10·96	...	,,	Banbridge, Milltown	2·96	...
,,	Skye, Dunvegan	8·66	...	*Antr*	Belfast, Cavehill Rd.	4·19	...
,,	Barra, Skallary	6·75	...	,,	Glenarm Castle	5·37	...
R & C	Alness, Ardross Castle	5·94	154	,,	Ballymena, Harryville	4·81	130
,,	Ullapool	5·41	112	*Lon*	Londonderry, Creggan	6·53	177
,,	Achnashellach	7·64	95	*Tyr*	Omagh, Edenfel	4·03	110
,,	Stornoway	5·38	...	*Don*	Malin Head	5·58	...
Suth	Lairg	4·27	114	,,	Dunfanaghy	5·65	...
,,	Tongue	5·07	121	,,	Killybegs, Rockmount.	5·95	106

Climatological Table for the British Empire, May, 1932

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L. mb.	Diff. from Normal mb.	Max. ° F.	Min. ° F.	Max. ° F.	Min. ° F.	½ max. and min. ° F.	Diff. from Normal ° F.	Wet Bulb ° F.	%	0—10	Am'nt in.	Diff. from Normal in.	Days	Hours per day	Per-centage of possible
London, Kew Obsy.	1011·4	— 4·5	74	35	59·7	46·2	52·9	— 0·5	48·0	87	8·0	4·03	+ 2·31	18	3·7	24
Gibraltar	1017·0	+ 0·9	85	50	74·4	55·5	64·9	— 0·6	54·2	78	4·3	0·61	— 1·12	4	..	..
Malta	1016·4	+ 1·9	84	53	72·6	59·6	66·1	+ 0·2	60·0	72	4·2	0·02	— 0·39	2	11·1	79
St. Helena	1015·3	+ 1·1	69	57	65·5	59·4	62·5	— 0·6	60·2	94	8·8	6·37	..	19	..	..
Sierra Leone	1012·7	+ 1·5	91	71	86·3	74·6	80·5	— 1·0	76·4	83	7·5	7·62	— 3·85	25	..	..
Lagos, Nigeria	1011·7	+ 1·1	90	72	86·0	76·0	81·0	— 0·8	77·0	83	8·7	11·34	+ 0·59	14	5·5	44
Kaduna, Nigeria	1012·1	— 0·6	96	66	90·7	71·5	81·1	+ 1·7	73·7	73	7·2	2·92	— 2·78	12	7·6	60
Zomba, Nyasaland	1015·8	+ 0·7	82	50	74·0	55·6	64·8	— 1·0	..	81	5·6	0·58	— 0·46	7	..	..
Salisbury, Rhodesia	1020·5	+ 1·0	80	43	71·9	49·4	60·7	+ 0·1	54·0	63	3·7	0·39	— 0·09	3	7·1	63
Cape Town	1018·7	+ 0·6	99	43	72·2	53·9	63·1	+ 4·2	54·5	81	4·9	4·99	+ 1·24	16	..	..
Johannesburg	1021·8	+ 2·3	72	37	64·6	45·5	55·1	+ 0·7	45·7	54	2·5	0·54	— 0·22	3	9·0	83
Mauritius	1017·3	+ 0·9	82	58	77·9	65·3	71·6	— 1·0	68·0	72	5·1	5·80	+ 2·77	17	7·9	71
Calcutta, Alipore Obsy.	1003·2	— 0·3	104	70	94·8	79·3	87·1	+ 1·0	79·1	81	5·5	11·74	+ 6·18	7*	..	..
Bombay	1006·1	— 1·3	95	77	92·2	80·1	86·1	+ 0·3	78·3	75	4·5	0·57	+ 0·02	2*	..	..
Madras	1004·8	— 0·6	107	76	93·7	80·2	86·9	— 2·9	78·3	69	6·5	0·59	— 1·25	3*	..	..
Colombo, Ceylon	1008·6	+ 0·2	90	72	85·9	76·3	81·1	— 1·7	77·9	82	8·5	28·98	+ 18·04	25	4·4	35
Singapore	1008·6	— 0·1	92	72	87·5	74·9	81·2	— 0·8	77·5	81	6·7	11·41	+ 4·77	17	6·1	50
Hongkong	1009·0	— 0·1	89	75	85·8	78·0	81·9	+ 4·5	78·0	81	6·9	2·51	— 9·56	9	7·3	55
Sandakan	..	..	89	74	87·2	76·3	81·7	— 0·8	..	..	..	4·55	— 1·78	15	..	..
Sydney, N.S.W.	1024·5	+ 5·9	73	45	66·2	52·4	59·3	+ 0·5	54·7	85	7·1	2·18	— 3·00	16	4·6	44
Melbourne	1025·4	+ 6·2	70	39	61·6	48·0	54·8	+ 0·7	50·8	84	8·1	0·59	— 1·57	9	2·7	27
Adelaide	1023·0	+ 3·0	81	44	69·5	52·4	60·9	+ 3·0	54·0	64	5·6	2·39	— 0·39	9	5·1	50
Perth, W. Australia	1016·5	— 1·9	83	45	70·1	55·0	62·5	+ 1·8	56·1	71	5·5	8·22	+ 3·25	15	5·5	53
Coolgardie	1018·4	— 1·0	82	37	71·0	48·9	59·9	+ 2·2	52·9	68	4·3	0·79	— 0·54	7	..	..
Brisbane	1021·6	+ 3·0	77	53	72·3	57·8	65·1	+ 0·5	59·2	69	4·7	1·66	— 1·15	11	6·1	57
Hobart, Tasmania	1023·3	+ 8·0	68	34	59·4	44·1	51·7	+ 1·2	46·5	74	5·6	0·35	— 1·55	4	6·0	62
Wellington, N.Z.	1017·3	+ 1·7	63	36	55·2	45·1	50·1	— 2·7	47·5	81	5·8	7·79	+ 3·11	14	5·0	51
Suva, Fiji	1012·9	+ 0·2	89	72	84·0	73·8	78·9	+ 2·4	75·5	86	6·6	8·87	— 1·20	23	4·4	39
Apia, Samoa	1011·0	— 0·1	88	70	86·3	75·2	80·7	+ 2.3	77·4	76	4·8	3·80	— 2·27	16	8·1	70
Kingston, Jamaica	1011·9	— 1·2	91	68	87·2	72·0	79·6	— 0·1	72·1	79	4·5	2·91	— 1·48	12	5·9	45
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1017·0	+ 2·1	83	32	64·3	46·3	55·3	+ 1·5	48·4	69	6·4	3·19	+ 0·40	13	7·2	49
Winnipeg	1017·0	+ 3·2	92	25	67·5	42·3	54·9	+ 2·9	42·7	71	4·8	0·73	— 1·27	4	8 4	55
St. John, N.B.	1015·6	+ 1·7	66	32	56·4	41·1	48·7	+ 1·0	44·7	69	5·3	2·63	— 1·08	11	6·8	46
Victoria, B.C.	1018·6	+ 1·9	76	41	59·4	46·1	52·7	— 0·3	49·4	74	5·7	0·29	— 0·84	5	9·1	60

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

facing **p.** *249.*



Haboob at Khartoum, June 7th. 1932 (see p. 262).

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The British Polar Expedition to Fort Rae

During the first International Polar Year in 1882-3 a combined British and Canadian expedition under Captain Dawson occupied Fort Rae on the shore of the Great Slave Lake in 63°N. In spite of its comparatively low latitude, this station was of great importance, especially for observations of terrestrial magnetism and aurora, because it lies very near the zone of maximum frequency of aurora which surrounds the magnetic pole. When the second International Polar Year was planned for 1932-3, one of the important aims was the determination of the change of the magnetic elements during the interval of fifty years, and for this purpose it was necessary to occupy as many as possible of the earlier stations. The re-occupation of Fort Rae fell to the British share, while other stations in the extensive sub-polar regions of North America were the objectives of Canada and the United States.

The British Expedition consists of a party of six, Mr. J. M. Stagg (leader), Mr. W. R. Morgans, Mr. P. A. Sheppard, Mr. A. Stephenson, Mr. W. A. Grinsted and Mr. J. L. Kennedy. Although the Polar Year did not officially start until August 1st, the party left England in May in order to have as long a time as possible for the construction of special huts, the erection of the instruments and generally to get the station into working order. They reached the settlement on June 19th, at the beginning of the short northern summer, accompanied by about

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600 cases of instruments and food, all of which had been specially packed because of the cost and difficulty of transport. Mr. Stagg writes: "Our recollection of the bustle of the early days at Rae is full of packing cases, curious Indian onlookers and swarms of hard-sucking mosquitoes, which, taking advantage of our occupation along other lines, had ample opportunity to feast on the fresh English blood they seem to relish so much.

"The first big jobs were the preparing of huts for instrumental gear. By earlier arrangements with the Hudson Bay Company and the Royal Canadian Mounted Police, of which there is a detachment here, we were spared the trouble of erecting dwelling-house and sleeping quarters. But other disused Indian shacks had to be converted and reconditioned. One, to house the photographically recording magnetic instruments, was made non-magnetic, light-proof and heat-insulated by building a double-walled chamber with wood-wool from our packing cases in the interspace and then fitted with a double door and piled up with turf and muskeg outside. Another old log hut was dismantled and transplanted from one end of the settlement to the other for manufacturing hydrogen in and filling our pilot and meteorograph balloons, while a third to house the engine generator and storage battery for the continuous lighting of the photographic recording instruments was largely reconditioned. A special completely non-magnetic hut for the absolute magnetic observations was built. Fortunately we found, ready made, a substantial log hut we could use for the main meteorological observatory and office.

"By the beginning of July many of the meteorological instruments were erected and observations begun, but it was nearer the beginning of August before the magnetograph chamber was satisfactorily complete and all the three independent sets of magnetic recorders properly settled down. By August 1st every instrument was functioning, and the complete routine of observations every three hours throughout the day was instituted. Already, in July, aurora had been noticed on several evenings and all during August there was a display every evening. Rae must be near, if not actually inside, the zone of maximum auroral frequency.

"From our early days here, the Indians have been amused spectators of our activities. The balloons we send off daily specially interest them. They feel sure that the unusually long rainless period we had in August had some connexion with the ultimate purpose and fate of the balloons in the high atmosphere, and attribute to us a specialised form of super medicine-man technique. A thunderstorm with lightning flash to ground near the settlement, nearer than they cared to recollect they had ever seen one before, confirmed them in this belief."

The new station is not actually on the site of that of 1882-3, but some 20 miles further up the lake in one of the largest Indian settlements in northern Canada. The old site was overgrown by bush, but the little island on which Captain Dawson erected his anemometer is still known by the natives as "White Man's Island." The old station has not been entirely abandoned, however, as the programme includes parallel magnetic observations at the old and new Forts to determine the secular change in the magnetic elements since the first Polar Year. Mr. Stagg adds: "We are taking advantage of the visits there to use the station as the other end of a base-line connecting the two Forts for simultaneous photography of aurora for height determinations. We had brought with us a light 'Silmalec' cable to be laid between the stations for use as a telephone line, but until the lake freezes in a few weeks we are using a couple of little wireless telephone transmitters which, though entailing a more elaborate technique in the auroral photography than the direct telephone line and less certain of maintaining communication during the disturbed periods when aurora appears, have already allowed us to get sets of parallactic photographs on two recent visits to the sub-station. These visits are made at this season by two members of the party in canoe and outboard motor, but when the lake is frozen dog-sledge will be our means of transport. We intend to occupy the Old Fort sub-station as frequently as possible throughout the auroral season.

"Working strictly in line with the recommendations of the International Polar Year Commission all our meteorological and associated work (such as atmospheric electrical observations) is done according to Zonal Mean Time, which for us is the time of the meridian 120°W., eight hours behind Greenwich; whereas the magnetic and auroral work, because of the more world-wide repercussions of activity in these fields, is carried on strictly according to Greenwich Time. The actual domestic time of the settlement is that of Canadian Mountain Time, seven hours behind Greenwich. Earlier in the season, when long daylight made day and night almost alike, the use of the three different times occcasionally led to disconcerting results."

All the meteorological instruments are running in duplicate except a few, such as the main Dines anemometer. Even if the latter were to fail, two other anemometers are mounted and in auxiliary use, one of the swinging-plate type specially made by Mr. L. H. G. Dines, and the other a Robinson 4-cup indicating type. The duplication is usually such that one instrument produces a record on the scale recommended by the International Polar Year Commission, seven days on each chart; this is to facilitate reproduction. The other instrument is generally a daily, open scale and more sensitive type, serving as a subsidiary in case of accident to or failure of the standard, and also to supply finer details than can usually be obtained from the weekly charts.

The party has found the Canadian people very helpful. During the journey out the Canadian National Railway Company " nursed " them right across the continent. Large supplies of tinned foods were presented by English and Canadian manufacturers, and all supplies were received safely. On the evening of August 1st a telegram was received conveying the good wishes of the National Polar Year Committee. At the time of the last despatch received from Mr. Stagg, dated September 18th, all the party were fit and working splendidly, looking forward to the experience of wintering in one of the world's reputed " cold poles."

Terrestrial Temperatures

By A. F. Dufton and H. E. Beckett,
Building Research Station, Garston, Herts.

In recent years, in the course of researches into the weathering of buildings, numerous observations have been made at this station of the surface temperatures of materials exposed to sunshine. The temperature in some instances has been found to exceed that indicated by a solar radiation thermometer (black bulb *in vacuo*), and it has been suggested that this phenomenon is likely to be of interest to meteorologists.

It is commonly thought that the temperature attained by a solar radiation thermometer is the maximum which can be recorded without concentration of the sun's rays, since the bulb of the thermometer is unable to lose heat by convection owing to the absence of air in the surrounding space. This idea, however, is fallacious. The temperature indicated by the thermometer is merely that at which the loss of heat by radiation to the surrounding glass globe (which is substantially at air temperature) is balanced by the energy received from the sun; in circumstances in which the loss of heat downwards is restricted, high temperatures may be attained by a material even when its upper surface loses heat by convection.

The surface of a specimen of bituminous roofing-felt laid horizontally on 1-inch boards with slag-wool underneath, for example, reached a temperature of 150°F. on a day when the air temperature rose to 69°F. and the black bulb to 133°F. On thin boards forming the roof of an ordinary wooden shed, bituminous felt has been found on a sunny day to reach a temperature identical with that of a black bulb *in vacuo.*

Within a well-insulated box, blackened internally and covered with a horizontal sheet of glass, temperatures as high as 250°F. have been frequently observed during warm sunny weather;

this is at least 100°F in excess of the corresponding temperature shown by a solar radiation thermometer. With this arrangement a blackened egg was successfully roasted.

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings are:—

January 16th, 1933.—*The relationship of climatic and geological factors to the position of soil clay and the distribution of soil types.* By E. M. Crowther (London, Proc. R. Soc. B. 107, 1930, pp. 1-30), and *Analyses of agricultural yield, Part IV : Water-table movements on a farm in Egypt.* By W. L. Balls (London, Phil. Trans. R. Soc. B. 221, pp. 335-75). *Opener*—Dr. B. A. Keen.

Royal Meteorological Society

The opening meeting of this Society for the present session was held on Wednesday, November 16th, in the Society's Rooms at 49, Cromwell Road, South Kensington. Prof. S. Chapman, F.R.S., President, in the Chair.

The Buchan Prize of the Royal Meteorological Society for 1933 has been awarded to David Brunt, M.A., B.Sc., for papers contributed to the *Quarterly Journal* and *Memoirs* of the Society during the years 1927-31.

J. Edmund Clark, Ivan D. Margary, Richard Marshall and C. J. P. Cave.—The Phenological Report, 1931.

1931 was officially described as "wet and dull," the emphasis is on the latter; yet it was the tenth successive year with excess of rain, the total being that of eleven average years. A fresh table gives for each of the thirteen districts the number of weeks showing "decided" and "excessive" divergence from the average for temperature, rainfall and sunshine. Out of the 572 events thus possible for sunshine during the spring and summer months there were only five decidedly bright against 72 dull. December, 1930 and November, 1931 were alone much on the warm side; March and September cold. There were no records of "excessive" warmth in spring and summer, but twelve of "cold." Such short cold spells in spring threw the flower records back half a week, and although migrants reached our coasts to date their progress inland was belated. Figure 4, with its areas of earliness and lateness in flowering, shows only small and scattered cases of the former, covering but one-tenth of our islands. Nearly half lay in north-west Ireland, with four days early, whilst Dartmoor fell 20 days behind its natural lateness. Slugs and weeds, as might be expected, caused exceptional trouble. Figure 6A, showing the average advance of migrant arrivals for 16 years, adds to the value of the associated tables. Thanks to a second broadcast in March, 1931, the corps of observers slightly exceeded 600. More would be specially welcome in west Ireland and north Scotland. The tables are based on more than 17,000 records.

Sir Napier Shaw, F.R.S, and Com. L. G. Garbett, R.N.—A new sort of wind rose.

In ordinary meteorological practice for the representation of wind conditions for stations on land or selected areas at sea, figures or roses for the several months are set out on separate sheets. Consequently, anyone who wishes to visualise the sequence within a year has to take note of information on twelve separate pages. In this paper examples are given of diagrams in which the results for the twelve months of the year are combined without sacrificing the information for the separate months. With some slight varieties of type various rose diagrams are exhibited to represent the normal conditions of wind (1) for St. Mary's, Scilly, (2) for the southern part of the North Sea, (3) for two parts of the same zone of latitude in the region of the SE. Trade Wind of the Atlantic, (4) for beyond the Roaring Forties of the South Atlantic Ocean, and (5) for the region of the monsoon of the Arabian Sea. Included also are corresponding roses for the surface level, 1,000 metres and 2,000 metres above Colombo, Ceylon, to exhibit results obtained with pilot balloons.

G. S. P. Heywood.—Katabatic winds in a valley.

This paper describes an investigation of katabatic winds in a valley of the Cotswolds. A Dines pressure-tube anemometer was erected in the valley, with the vane 15 feet above the ground. The meteorological station at Leafield was situated 2½ miles away, and the records of the anemometer of that station were compared with those obtained in the valley. The speed of the katabatic flow was seldom greater than 1 m./s., when a katabatic flow was taking place, and the temperature records at Leafield showed an inversion on all those occasions. The conditions which lead to the cessation of the katabatic flow are discussed, and some observations of smoke drift show that katabatic flow may occur in a layer near the ground without influencing the anemometer at 15 feet.

Correspondence

To the Editor, *The Meteorological Magazine.*

The Colour of Moonlight

Dr. Simpson's letter in the November number of the *Meteorological Magazine* presents us with two distinct problems (1) why is blue commonly regarded as the colour of moonlight?

(2) assuming, with Mr. Bonacina, that the night sky is usually without colour, why should a blue coloration sometimes be observed in the night sky when there is a full or nearly full moon?

Physiological considerations in regard to colour vision no doubt enter into the first problem to some extent, but I think we may accept as a fact the statement that there is no physical reason why a blue coloration should ordinarily be associated with moonlight. That being so we can dismiss the moon itself from the problem and consider merely what is observed under conditions of faint daylight illumination. On the evening of November 23rd the sky was overcast, and in the company of an observer, Mr. B., who did not know what was afoot, I took up a position in a room where the faintly illuminated grey sky could be seen through a window. The electric light was switched on, and I asked Mr. B. to say what colour the sky appeared to be. The reply was "Air Force blue." I then switched out the light and he agreed, without hesitation, that the sky now appeared grey without a trace of blue coloration. Half an hour later the sky, which was still overcast, when viewed from the brightly illuminated street appeared to have the typical deep blue colour used by artists to depict the night sky. There was no doubt at all, however, that it was really grey.

The explanation of this illusion is very simple. Ordinary sources of artificial illumination are deficient in blue rays. Consequently we may describe faint daylight, or moonlight, as equivalent to artificial light plus blue. When you look at the sky through a window in an artificially illuminated room the common ingredients of the two illuminations are ignored and the excess of blue outside forces itself upon your attention, with the result that your mind creates, so to speak, a blue coloration that does not in fact exist. Blueness has thus become associated in our minds with nightfall and, therefore, with moonlight. If you get away from artificial lights and give your eyes a chance to see things as they are, the fact that the blueness is a pure optical illusion at once becomes manifest.

We are now faced with Mr. Bonacina's statement that the night sky is really blue in certain circumstances. Now it is well known that the blue of the sky in the daytime is due to the scattering of sunlight by small particles, and there is only one difficulty in explaining a blue sky at night in the same way. The difficulty is that our colour sense disappears at low illuminations, and what one wants to know is whether the scattered light from the sky under conditions of bright moonlight is above the threshold value for the perception of colour. I should, personally, have thought not. Mr. Bonacina made his observation in the "late evening." Was it not possible that the blue tint he observed was really due to the last vestiges of daylight? Has anyone ever observed anything of this kind at midnight?

E. G. BILHAM.

November 24th, 1932.

The Blue Colour of Moonlight

Dr. Simpson asks in the November number of this magazine if anybody can say why moonlight appears bluish. Not that I even for a moment imagine that I could give a satisfactory explanation of that well-known fact—or is it an illusion?—But it has always seemed to me that even the strongest moonlight is totally insufficient to enable us to see the surrounding objects in their true colours, while quite strong enough on the other hand to be scattered and turned to a bluish tinge by small particles in the clear sky or in the remoter parts of the air above the landscape.

The result of this lack of intensity would seem to be that the landscape around us, not illuminated strongly enough to give us the impression of red, yellow, green and so on, is practically seen as a composition in black and white, viewed, however, through a very real bluish haze, and capped and dominated by a blue sky, the colour of which is real also and not an optical illusion. So much for the facts, which I would suggest can be explained by optical laws.

Now it further seems to me that in most cases the vividness of the phenomenon is exaggerated by illusion. We are all subject, I think, to the illusion that the intensest lights in our circle of vision—at least when not flagrantly red or green or violet—are white or so nearly so as to make no difference, and can be safely taken as a fixed base for judging other colours. For instance, at the moment I'm writing this at about 4 p.m. on a November afternoon, by the light of a really quite yellowish electric lamp; the sky, which is visible through my window, appears a vivid violet by contrast. Now even our whitest lights are yellowish in the extreme, and I expect that hardly anybody nowadays is ever looking at a moonlit landscape without having a few of our civilised lamps included in his range of vision. Even a distant pin-point of artificial "white" light produces the contrast necessary for the illusion. To find out how much of the bluishness is real, and how much optical illusion, we can resort to the very simple experiment of first looking up at the moon—to see what real white looks like—and immediately afterwards at the moonlit landscape.

We see then that an appreciable percentage of the blue tinge—that for which other factors can therefore be held responsible—has disappeared, but still the landscape looks bluish.

I think, therefore, that the cause of at least part of the blue colour can be no other than the fact that the intensity of light from the full moon never reaches a certain value, necessary for the human eye to distinguish such bright colours as tend to raise a landscape above the level of a monochrome.

J. C. M. Kruisinga.

Vriezenveen, Overyssel, Holland. November 26th, 1932.

An Unusually Brilliant Lunar Halo

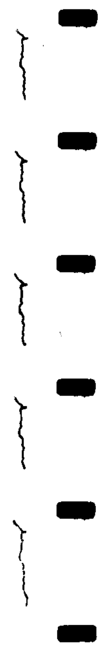
A lunar halo (22°) of extreme brilliance was observed on the morning of September 22nd, 1932, at 4h. 30m. G.M.T. When first seen the sky was half covered with well-defined cirrus and cirro-stratus, which moved fairly rapidly from south-west to north-east and gave rise to a perfect halo.

The planet. Venus, an already brilliant object in the sky to the south-east, later became affected by the veil of cloud and in turn, a tiny halo of diffused light became visible around it. The spectacle was, however, of short duration (20 minutes) owing to obliteration by dense cirro-cumulus in the transitional stage to alto-cumulus. With the passing of the alto-cumulus a lunar corona was visible at 4h. 55m. G.M.T. for a few minutes.

C. A. Jupp.

R.A.F. Station, Upper Heyford, Oxford. September 25th, 1932.

Duration of Lightning Flash



I do not know the record length of the existence of a lightning flash, but the accompanying enlargement of a portion of a ciné film may be interesting as giving evidence of a duration of approximately $\frac{5}{8}$ second.

During the night of August 12th while a violent thunderstorm was in progress at Netley Bridge, Inverness-shire, I thought it might be amusing to take a ciné picture, to see what would come out; for the flashes were so continuous that the landscape seemed to the naked eye to be almost always in view. Nothing of this came out on the film, but a single flash in front of the camera was recorded on five successive pictures. The first four of these are strong, the third being rather more prominent than the others, but the fifth is much fainter with a relatively strong representation of particular points on the flash. The preceding section of the film shows no trace of the flash. The reproduction is, of course, a negative.

My camera is an early form of the Pathé Baby ciné and runs at approximately 8 pictures a second. The black rectangles are, of course, the holes in the film by which it is drawn forward into position for each exposure. The film measures 7½ mm. from centre to centre of successive rectangles.

M. M'Cullum Fairgrieve.

37, *Queens Crescent, Edinburgh. November 20th,* 1932.

The Weather of October, 1932

I am surprised to read in the *Meteorological Magazine* for November, 1932, under the heading "The Weather of October, 1932," that "on the 1st there was a gradual drop of temperature as northerly winds penetrated southwards," etc. This was certainly not the case in the southern half of the country, as, generally speaking, temperature fell from 60°-65°F. to 30°-35°F. within 18 hours, and from 60° to 40° within 4 or 5 hours. Saturday, October 1st, was very warm forenooon with temperature above 60°, until the wind veered WNW. and NW. in the afternoon about 3 p.m., with heavy rain when the thermometer fell rapidly, being below 50° by 6 p.m. This is what occurred in the Isle of Wight, and I think it was general, at any rate in the southern half of the country. It was summer on Saturday, October 1st, up to 3 p.m., while by dawn the next morning, Sunday, October 2nd, there was rime on the grass, and winter! Can this be termed a "gradual" drop of temperature? I think not.

J. E. COWPER.

4a, Moreton Terrace, S.W.5. November 23rd, 1932.

[Mr. Cowper's criticism is valid for the south of England but not for the remainder of the British Isles, where the difference between the maximum on October 1st and the minimum during the following night was little more than the normal diurnal variation.—ED., *M.M.*]

The Vivid Meteor of September 26th, 1932

It may be of interest to state that the vivid meteor seen at Eskdalemuir at 18h. 31m. G.M.T. on September 26th and described in the October number of the *Meteorological Magazine*, was also seen at Aberdeen. Unfortunately the exact time of the observation cannot be given, but it was somewhere about 18h. 25m. G.M.T.

When first seen the meteor was between south-south-east and south, at an elevation of about 8°, and appeared to be moving towards the south-south-west, dropping quickly in elevation till it disappeared behind the roofs of a line of buildings after having been observed for about two seconds. The meteor, even in the daylight then existing, appeared to be at least four times as bright as Venus at the latter's maximum brilliancy, and was of a white or pale bluish-white colour. No definite tail was observed; the meteor appeared like a very bright star, but this brightness, coupled with the fact that the meteor was receding along the line of sight, may have sufficed to foreshorten and render invisible any tail which may have been present.

G. A. CLARKE.

Aberdeen Observatory. October 31st, 1932.

The Humours of Inspection

I thought the following were so good that they really ought to find a place in the *Meteorological Magazine* :—

An inspector of meteorological stations in a British Colony, during his inspection of a station, asked the administrative officer about the observations of temperature. "Oh," said the administrative officer (with an Oxford accent) very definitely, " I can vouch for those; I always take them myself and never leave them to the native observer. If it is wet I get him to bring the thermometers in for me to read them! "

During the same tour of inspection, the inspector came to a rainfall station in charge of an equally responsible official, who informed him that the measuring glass of the rain-gauge was broken. " Why," said the inspector, " did you not report it and get a new one? " " Oh," said the officer, " I thought it was not necessary; I copied the scale of the glass and put it on the side of a wine bottle and used that."

E. GOLD.

December 6th, 1932.

Mirage off Newfoundland

I witnessed a remarkable and rather amusing sight whilst on the coast of Labrador this summer.

I was on meteorological work in connexion with the air mail service for the Imperial Conference at Ottawa. The air mail had to be transferred from the *Empress of Britain* in the Straits of Belle Isle to the aircraft, which flew it to Ottawa. At 8h. on August 17th, this procedure was in progress, and although it was perfectly clear and sunny where I stood on the shore, there was an extensive layer of fog at the scene of operations, about three miles out, and only the smoke of the *Empress* was visible above the layer. After watching for several minutes I was startled to see the *Empress* above the fog completely upside down with her hull pointing skywards and her masts apparently resting on the layer of fog. The illusion lasted for about one minute and was perfectly clear in every detail when it finally disappeared and the ship came out of the fog in its normal position.

On a previous occasion I saw three mountains on the Newfoundland coast, fifteen miles distant; their summits appeared to be resting on the water while the bases were pointing skywards.

JOHN R. SHERWOOD.

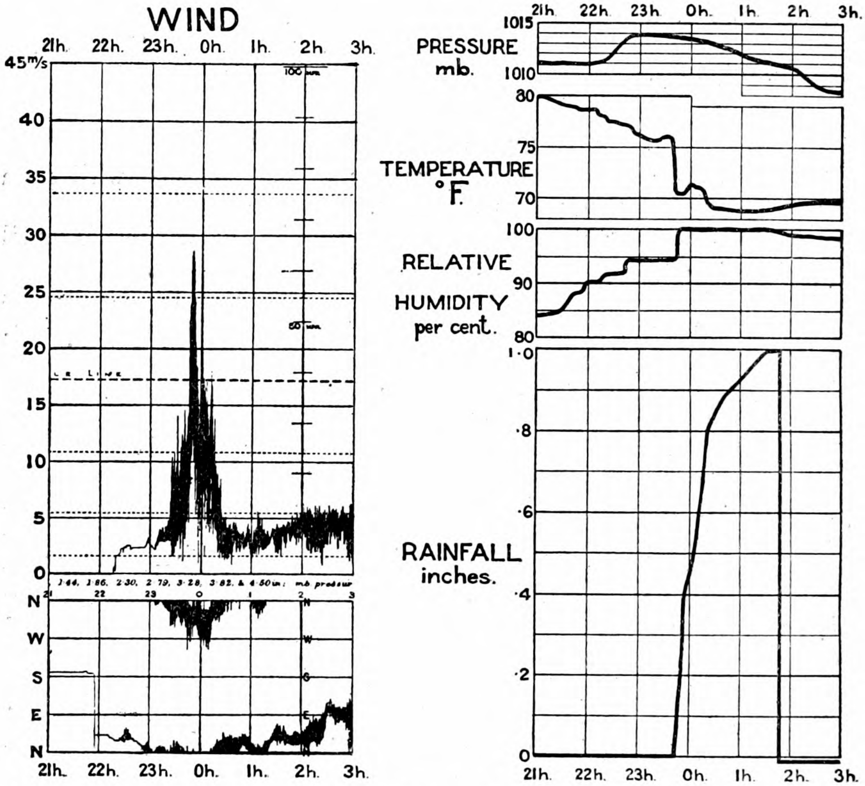
Royal Canadian Air Force, Camp Borden, Ontario, Canada.
November 10th, 1232.

NOTES AND QUERIES

Autographic Records of a "Sumatra" Squall

Mr. V. A. Lowinger, Surveyor-General, Malaya, recently forwarded to the Meteorological Office copies of interesting autographic records showing the passage of a " sumatra " squall. These records, which are believed to be the first of their kind received in this country, were taken at Bukit Jeram, on the west coast of Malaya, one of several first-order stations established in recent years by the Malayan Meteorological Service.

Mr. Lowinger remarks " This is the highest wind velocity recorded at any station in Malaya since we commenced installing the Dines anemometers in 1928. The records are also of interest in showing the typical features of a ' sumatra '—note the distinct rise in pressure immediately before the passage of the squall. The fall in temperature, commencement of rain, rise in humidity, and highest wind velocity occur practically simultaneously." As may be seen from the portions of the records reproduced, the start of intense rainfall coincided with the sudden rise of wind above the " gale line "; 0·7 in. of rain fell in the first half-hour, after which 0·3 in. fell in an hour and a half. The highest velocity shown during the squall was 64 m.p.h., but this figure may well have been exceeded slightly, as the earlier part of the record (not reproduced) suggests that the velocity pen was not marking well on the upward movements.



Autographic records at Bukit Jeram, Malaya, Lat. 3°15′N., Long. 10 18′E., from 21h., July 15th, to 3h., July 16th, 1932.

Amongst published descriptions of " sumatras " of the Malacca Strait it is stated* that " the whole change (of wind) . . . . happens simultaneously along a more or less straight line which may be 200 miles or more in length.'' In this case the evening maximum and the succeeding early morning minimum on the barogram, instead of showing the usual smooth curve tend to a " V " shape, which, however, is little evident on the figure—where the time-scale of the barogram has been expanded to fit that of the anemogram; but there is no sign of the *crochet de grain* associated with a line sqall in the latitude of the British Isles. It seems more probable that the " sumatra " is of the same type as the West African " tornado." The " sumatra " appears to die away within about 30 miles of the coast; of a number of storms recorded at Pintu Gedong, Port Swettenham, which lies about 20 miles south of Bukit Jeram, it is stated* that 60 per cent have disappeared or lost all force by the time they arrive in Kuala Lumpur, 28 miles away. " The Malacca Strait Pilot "† describes " sumatras or squalls from the south-west " and a less frequent phenomenon, " north-westers "; whether there is any essential difference between the two phenomena seems doubtful, but a decision on this as on many other doubtful points in the annals of " local winds " can be reached only with the aid of a series of autographic records.

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*Malayan Meteorological Service, Summary of Observations, 1931.

It is to be hoped that in due course the Malayan Meteorological Service will be able to give an investigation on modern lines of the " sumatra."

S. T. A. Mirrlees.

Rain Spells and Wet Spells at Newquay

Dr. C. C. Vigurs, Meteorologist to the Newquay Urban District Council, has forwarded some statistics as to the frequency of rain spells‡ and wet spells§ at Newquay. These statistics are available for the 39 years 1893 to 1931 and are summarised below:—

	No. of spells	Mean duration		Longest spell		No. of years with		
		Days	Mean rain per day	Days	Mean rain per day	None	1 or 2	3 or 4
			in.		in.			
Rain spells	63	20·2	0·21	35	0·17	5	26	8
Wet spells	13	18·8	0·28	24	0·15	28	11	0

Both the number of rain spells and wet spells are appreciably greater than those experienced at Camden Square (London), where during a similar period there were only 5 rain spells

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***London, Q.J.R. Meteor. Soc.*, XLIX, 1923, p. 237.

†London, Admiralty Hydrographic Dept., 1924.

‡A rain spell is a period of at least 15 consecutive days to each of which is credited ·01 inch of rain or more.

§A wet spell is a period of at least 15 consecutive days to each of which is credited ·04 inch of rain or more.

and no wet spells, the mean duration of the rain spells being 17 days.

The number of days with rain increases steadily from the south-east to the west and north of the British Isles, owing to the greater number of depressions and secondaries affecting north-western districts. Thus the average number of rain days for the period 1881 to 1915 was 163 at Camden Square and 252 at Enniscoe House, near Crossmolina in the north-west of Ireland. At Newquay the average number of rain days was 198 (rainfall 33.22in.). The corresponding values for rain spells for the two stations during the same period are set out below :—

	No. of rain spells	Mean duration		Longest spell		No. of years with			
		Days	Mean rain per day	Days	Mean rain per day	None	1 & 2	3 & 4	5 or more
			in.		in.				
Camden Square (London)	4	15·5	0·16	16	0.22	31	4	0	0
Crossmolina (Enniscoe)	153	24	0·25	62	0.27	0	4	13	18

There were 81 wet spells at Crossmolina (Enniscoe) during the period 1881-1915, and none at Camden Square.

These statistics demonstrate that while the number of days with rain is greater at Newquay than at London, it is appreciably less than at stations in the north-west of the British Isles.

Of the 63 rain spells, recorded during the 39 years at Newquay, only 8 occurred during the seven months March to September. Such rain spells as occurred were confined almost entirely to the four months January, February, October and December.

J. Glasspoole.

Haboob at Khartoum

The photograph forming the frontispiece of this number is one of several sent by Mr. R. H. Matthews and taken at Khartoum by Sergt.-Major Hayward, who writes :—

" A haboob occurred here on June 7th, while we were having our afternoon's siesta. Word went round that there was a haboob coming, so we all went out to see it. We could look out over the Blue for a distance of about twenty miles, and could see what looked like small pillars of sand. I mounted on the roof with a camera and waited. I suppose it took about thirty minutes to arrive, and just before it burst over us I want you to imagine brilliant sunshine with a towering wall of miles of sand. I took the pictures and ran for shelter, and had just reached the bunk and shut doors when instead of sunshine came impenetrable blackness, wind roaring outside, and heaps of sand coming in everywhere. This lasted for about three-quarters of an hour, and then sunshine again. The camp looked terrible, with sand everywhere and in everything."

The photograph selected for illustration shows clearly the "buttressed" character of the sand wall. These buttresses are caused by whirling columns of air preceding the advance of the main wall and merging into it.

Wind Velocity in a Tornado

The *Bulletin of the American Meteorological Society* for August and September contains some calculations by Mr. J. D. Marshall, Consulting Engineer, of wind velocities during a tornado at Washington, Kansas, on July 4th, 1932, from the pressure required to cause certain types of damage. A railroad switch signal was bent over by the wind, the estimated velocity being 210 m.p.h. A railroad crossing warning sign was blown down flat, the estimated wind velocity being 128 m.p.h. The most reliable estimate, however, was obtained from the blowing down of a steel standpipe for water storage, requiring an estimated velocity of 145 m.p.h. The tornado was well developed, causing a large amount of damage. On previous occasions velocities have been estimated as high as 400 m.p.h., but probably on insufficient evidence.

A Lunar Rainbow

Mr. Kidson, Director of the New Zealand Meteorological Service, has sent the following extract from the *Southland Times* of August 24th, 1932:—

"The unusual spectacle of a lunar rainbow was observed by two women residents of Otahuhu shortly after five o'clock on Wednesday morning, states the *New Zealand Herald*. Rainbows formed by moonlight are usually very faint and the colours are generally difficult to distinguish. However, it was stated by one of the observers that the lunar rainbow was almost as clear as those seen in daylight, and the reflection of the bow in the Tamaki river was most impressive."

Bibliography of Actinometry

In any scientific research one of the first essentials is a summary of the previous literature on the subject, but scientific papers are so scattered, and many of them are so long and difficult, that this preliminary is often a research in itself. Most specialists prepare and keep up to date their own collections of abstracts, and some valuable compilations prepared in this way have been published from time to time in book form. The International Actinometric Laboratory of Trappes has made a further step, and includes in its programme of work the formation and publication of an annotated bibliography of actinometry which will be added to year by year.

The enterprise owes its inception to M. Volochine, and proposes first the issue of abstracts of recent papers, to be followed by those published during the past 30 years, to a total of about 2,000. When the retrospective bibliography is completed, the normal issue will consist of 300 to 400 sheets a year. The cost will depend on the number of subscribers, but thanks to the facilities of reproduction offered by the National Meteorological Office of France, it will be small.

We have now received the first three instalments totalling 203 sheets, mainly dealing with papers by C. G. Abbot, C. E. Brazier and L. Gorczynski. Each abstract is on a separate sheet, headed by the author's name, to facilitate filing. They form an excellent commencement, and the issue of further series will be awaited by meteorologists with interest.

Reviews

India Meteorological Department, Scientific Notes. Vol. iv, No. 39. *A Study of the Structure of the Bay Storm of November,* 1926, by Sobhag Mal, M.Sc., and B. N. Desai, M.Sc., B.A.

The Bay of Bengal storm of November, 1926, took an unusual track, moving in a north-easterly direction instead of the usual north-westerly one, and in this paper the authors have investigated the cause of its unusual movement and also if its structure resembled the structure of the depressions of middle latitudes. From the synoptic charts of the period 19th to 26th, observations from ships' logs, upper wind observations from Port Blair, and rainfall, temperature and humidity observations at various stations, a front analysis has been made from the initial stages of the storm up to its dissipation. A series of 17 charts is reproduced in the paper giving the position of the fronts at various stages of the storm.

The disturbance in its early history seems to have formed by the protusion of a tongue of warm moist southerly or south-easterly air into a relatively cold current from east and north-east, thus forming a warm sector. Until the disturbance developed into storm proportions, its movement was more or less the same as that of the air in the warm sector. The disturbance appears to have intensified into a storm after the development of a back-bent occlusion acting as a second cold front, and the storm then moved in a north-easterly direction, *i.e.*, in the direction of the south-westerly winds in the sector between its first and second cold fronts. Indirect evidence is produced that the second cold front had a considerably greater temperature and wind contrast at its boundary than did the first one, and the intensification of the disturbance after the appearance of the second cold front seems to have been due to the artificial enlargement of the warm sector in the manner pointed out by Bjerknes and Solberg for some depressions of middle latitude. When the south-westerly current was cut off by the north-westerly current behind the second cold front the storm weakened rapidly and dispersed. Surface air trajectories for the Bay are reproduced in the paper and confirm in a convincing way the existence of three different sectors in the storm, the air masses in each having different properties owing to their different origin. The characteristics of the three different sectors and the surfaces of discontinuity of the storm are summarised by the authors and compared with the corresponding features of the depressions of middle latitudes.

The authors are to be congratulated on the way in which they have made full use of the somewhat meagre data at their disposal and carried out a very interesting and, on the whole, convincing analysis of the structure of this storm of low latitudes.

W. C. Kaye.

India Meteorological Department. Scientific Notes. Vol. I, No. 9. *Comparison of temperatures in Stevenson screens at heights of 6ft., 4ft. and 2ft.* By K. R. Ramanathan, M.A., D.Sc., and Vol. II, No. 11. *Comparative observations of temperature inside white painted, unpainted and black painted Stevenson screens.* By Barkat Ali, M.Sc.

In the first paper, an analysis is made of a year's observations of temperature and humidity at about 8.30 a.m., and of maximum and minimum temperatures in Stevenson screens at Agra. Screens were mounted with bases at heights of 6ft., 4ft. and 2ft. above the ground. It appears that of the elements considered, minimum temperatures are most affected by deviations from the standard height, and to keep the errors small, the deviation of the height of the base of the screen above ground from the standard of 4ft. should not exceed 4in. In the second paper, a comparison is made of temperature inside white painted, unpainted and black painted Stevenson screens. The conclusion reached is that so long as screens are not painted a dark colour, the type of paint used is immaterial, and apparently lack of regular re-painting is not likely to have any appreciable effect on the records of temperature.

S. T. A. Mirrlees.

Obituary

Mr. Thomas Duncan Bell.—We regret to announce the death on November 24th of Mr. T. Duncan Bell, at the age of 78. Mr. Bell was born on June 14th, 1854, and educated at Lewisham Congregational School. He joined the staff of the Meteorological Office in November, 1869, as a temporary clerk; at first he was attached to the Observatory Branch, but he was soon transferred to the General Office or Correspondence Department under Mr. J. S. Harding, the chief clerk. At this time the library formed part of that department, and this became Mr. Bell's special charge. Among other innovations he replaced the cumbersome ledgers by a card catalogue under authors, and later instituted a subject card catalogue, employing the classification published by the Royal Society in the International Catalogue of Scientific Literature. He also took a large share in the preparation of the 14 volumes on meteorology in the International Catalogue from the beginning in 1899, both in collecting the material published in the British Isles and in coordinating the data from abroad. In 1906 he was promoted to principal assistant in the Statistics and Library Branch, and to his work on the library was added the task of dealing with inquiries of all kinds, both personal and by letter, under the supervision of the Superintendent of Statistics. It was at this stage of his career that he was first known to me, and the impression of his work which I received was of efficiency without fuss. This was nowhere better displayed than in his handling of legal inquiries; a difficult and responsible duty in which he earned general approbation. In April, 1914, he succeeded Mr. J. A. Curtis as chief clerk, a position which he held throughout the difficult period of the War until his retirement on March 31st, 1920.

In his private life Mr. Bell was well known to a large circle of friends. In 1873 he was admitted to the Camberwell Green Congregational Church, of which he was elected a deacon in April, 1891, at the early age of 37. In June, 1891, he became church secretary, a post which he held until June, 1929, and in 1927 he was Chairman of the London Congregational Union. He also played a part in municipal politics, serving as Alderman of the Borough of Camberwell from 1900 to 1903 and Councillor from 1903 to 1906.

An impressive funeral service at the Camberwell Green Congregational Church on November 29th was attended by a large gathering which included a number of Mr. Bell's official colleagues.

C. E. P. Brooks.

News in Brief

Meteorological Committee.—Professor S. Chapman, F.R.S., has been chosen as representative of the Royal Society in place of Sir Arthur Schuster, F.R.S., who has resigned. Capt. J. A. Edgell, O.B.E., R.N., has succeeded Vice-Admiral H. P. Douglas, C.B., C.M.G., as Hydrographer to the Navy and as representative of the Admiralty on the Meteorological Committee. Sir

Henry Lyons, F.R.S., has been appointed Vice-Chairman of the Committee in place of Sir Arthur Schuster, F.R.S.

We learn that the Governor of Sierra Leone is introducing into the Legislative Council a Daylight Saving Bill to enable the clock to be put forward twenty minutes from October 1st to March 31st. The change came into operation this year on December 1st.

We learn from *Nature* that a Roosevelt Medal for achievement in science has been presented to Dr. Robert Andrews Millikan, director of the Norman Bridge Laboratory of Physics and chairman of the executive council of the California Institute of Technology.

Prof. Dr. R. Süring retired from the Directorship of the Meteorological and Magnetic Observatory on the Telegraphenberg, Potsdam, on October 1st, 1932.

Prof. Dr. Kurt Wegener has been appointed Professor of Meteorology and Geophysics at the University of Graz as successor to his brother, the late Prof. A. Wegener.

Errata

November, 1932, page 234, line 8, *for* " other arcs tangent to the 45° halo have been seen on about the horizontal " *read* " other arcs tangent to the 22° halo have been seen at about 45° from the horizontal."

October, 1932, page 214, fifth line from the bottom of the page, *for* " at an elevation of 40° " *read* " at an elevation of about 20°."

The Weather of November, 1932

Except for the western coast of North America, Greenland, Iceland, Spitsbergen, the northern coast of Russia, northern Egypt and around Madeira, pressure was above normal from Alaska across North America, the North Atlantic and Europe to Russia and Turkey. The greatest excesses were 9·8mb. at 50°N., 50°W. and 5·8mb. at Lemberg, while the greatest deficit was 5·4mb. at Isafjord. Temperature was above normal in Spitsbergen and northern and central Europe, while rainfall was below normal in western and central Europe and parts of Scandinavia, but 70 per cent. above normal in Svealand and 25 per cent. above normal in north-west Gothaland and south-east Norrland.

The outstanding feature of the weather of November over the British Isles was the marked deficiency of both sunshine and rain. Lympne reported the smallest November total (26 mm.) for rainfall since the station opened in 1920 and Liverpool the lowest November total (35 hrs.) for sunshine since 1908 when the sunshine records started there, while at Kew the total of 26 hrs. was the lowest total for sunshine since 1888. During the first four days a complex area of low pressure passed across the country giving mild unsettled weather generally with fairly heavy rain and local strong winds or gales in the north and west on the 2nd and 3rd, 1·54 in. fell at Tiree on the 3rd and 1·46 in. at Tynywaum (Glamorgan). 60°F. was reached at many places in England and Ireland on the 2nd and 3rd. On the 5th a high pressure area spread eastwards and anticyclonic conditions prevailed from then until the 18th. The 5th was generally sunny over the whole country with 8 hrs. and more of bright sunshine at Leuchars, Eskdalemuir, Armagh, Valentia, Cockle Park, Stonyhurst, Blackpool, Llandudno, Colwyn Bay, Aberystwyth and Pembroke, but later sunshine records were rather poor, only a few places having good records occasionally, *e.g.*, 8·1 hrs. at Oxford on the 7th, 6·9 hrs. at Auchincruive (Ayr) on the 13th. The weather during this period was mainly rather cold and quiet with local drizzle or slight rain at times, the 7th was very cold in Scotland a maximum of 33°F. being recorded at Renfrew, and the 18th very cold in England, the maximum at Birmingham being 37°F. The 18th was a particularly sunless day, the largest amount of sunshine reported being 0·4 hrs. at Lerwick. Much mist or fog occurred locally during this time. From the 19th to the end of the month depressions centred to the north of the British Isles moved north-eastwards and caused unsettled weather with fairly heavy rain at times and bright periods. Thunderstorms occurred in the north and west on the 22nd and 23rd, while strong winds and gales were experienced in the north and west on these days and over the country generally on the 26th and 27th. Snow and sleet fell in parts of Scotland between the 21st and 26th and hail locally in the Midlands, but it was milder further south. The 28th was a generally sunny day with no rain at most places—7·0 hrs. of bright sunshine were experienced at Clacton and 6·9 hrs. at Ross-on-Wye. On the 29th and 30th strong winds and gales occurred first in the north and later in the south, and a belt of heavy rain moved in a southerly direction across the country—1·95 in. fell at Llyn Fawr (Glamorgan) on the 29th and 2·50 in. at Holne (Devon) on the 30th. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	46	+ 3	Liverpool	35	—24
Aberdeen	56	+ 1	Ross-on-Wye	49	—14
Dublin	60	—11	Falmouth	51	—25
Birr Castle	48	—16	Gorleston	43	—19
Valentia	52	—13	Kew	26	—26

The special message from Brazil states that the rainfall in the northern regions was generally scarce, the average being 0·67 in. below normal and in the central and southern regions irregular with averages 0·04 in. and 0·20 in. above normal respectively. Seven anticyclones passed across the country, which was, however, partly under the influence of the prevailing continental depression. The crops were in good condition. At Rio de Janeiro the mean pressure for the month was normal and the mean temperature 0·4°F. above normal.

Miscellaneous notes on weather abroad culled from various sources. Bad weather was experienced over the Black Sea about the 6th. Violent storms were reported off north Norway early in the month and near Iceland about the 12th. Exceptionally severe thunder and hail storms devastated a large area of the province of Calabria about the 10th. Bridges were swept away and the country flooded—17 deaths occurred while numerous families were rendered homeless. A waterspout swept over a large tract of the Beira province of Portugal, causing the rivers to inundate fields and vineyards and destroying a large olive-oil factory. Navigation closed at Uleaborg (Finland) on the 26th, but Neva Bay and Kronstadt were ice free (*The Times*, November 7th-December 1st).

A typhoon struck the Luchu Islands on the 14th and then passed up the coast and raged over Tokyo from 11 p.m. to 4 a.m. The Hakone Observatory registered a wind velocity of 46 m/s. (nearly 98 m.p.h.) at the height of the storm. A landslip occurred at Yokohama about the same time—23 people were killed in all and 108 injured or missing. The steamer *Unkai Maru* was lost during the typhoon, but part of the crew were saved. (*The Times*, November 16th-17th.)

It is estimated that 3,000,000 banana trees were destroyed by the strong winds accompanied by heavy rains which occurred over Jamaica between about the 3rd and 7th. On the 8th a hurricane struck the western side of Jamaica and the incessant rain caused landslips. The hurricane then swept over the Cayman Islands and across Cuba from Santa Cruz del Sur to Port Nuevitas affecting an area 100 miles wide. By the 12th it was centred opposite Wilmington, North Carolina, about 500 miles off the United States coast. About 2,000 persons were killed in Cuba and 67 in Cayman Brac, and extensive damage was done to crops and property. The wind velocity is reported to have reached 125 m.p.h. (*The Times*, November 8th-14th.)

Rainfall, November, 1932—General Distribution

England and Wales	69	per cent of the average 1881-1915.
Scotland	86	
Ireland	58	
British Isles	71	

Rainfall: November, 1932: England and Wales.

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Lond .	Camden Square	1·38	58	*Leics* .	Belvoir Castle	1·67	75
Sur .	Reigate, Alvington	1·41	45	*Rut* .	Ridlington	1·67	73
Kent .	Tenterden, Ashenden	1·09	36	*Lincs* .	Boston, Skirbeck	1·50	75
,, .	Folkestone, Boro. San.	1·28	...	,,	Cranwell Aerodrome	1·56	83
,, .	Margate, Cliftonville	·82	34	,, .	Skegness, Marine Gdns	1·37	63
,, .	Sevenoaks, Speldhurst	1·12	...	,, .	Louth, Westgate	1·85	72
Sus .	Patching Farm	1·74	49	,, .	Brigg, Wrawby St.	1·34	...
,, .	Brighton, Old Steyne	1·36	43	*Notts* .	Worksop, Hodsock	1·06	54
,, .	Heathfield, Barklye	2·09	56	*Derby* .	Derby, L. M. & S. Rly.	1·67	77
Hants .	Ventnor, Roy. Nat. Hos.	2·60	81	,, .	Buxton, Devon Hos.	4·40	94
,, .	Fordingbridge, Oaklnds	2·17	63	*Ches* .	Runcorn, Weston Pt.	2·71	98
,, .	Ovington Rectory	2·32	70	,, .	Nantwich, Dorfold Hall	2·78	...
,, .	Sherborne St. John	1·58	55	*Lancs* .	Manchester, Whit Pk.	2·63	100
Berks .	Wellington College	1·27	50	,, .	Stonyhurst College	3·32	73
,, .	Newbury, Greenham	1·82	65	,, .	Southport, Hesketh Pk	2·64	84
Herts .	Welwyn Garden City	1·67	...	,, .	Lancaster, Strathspey	3·03	...
Bucks .	H. Wycombe, Flackwell	1·86	...	*Yorks* .	Wath-upon-Dearne	1·26	62
Oxf .	Oxford, Mag. College	1·19	54	,, .	Bradford, Lister Pk.	2·20	75
Nor .	Pitsford, Sedgebrook	...	...	,, .	Oughtershaw Hall	5·87	...
,, .	Oundle	1·23	...	,, .	Wetherby, Ribston H.	2·18	93
Beds .	Woburn, Crawley Mill	1·22	54	,, .	Hull, Pearson Park	1·58	72
Cam .	Cambridge, Bot. Gdns.	...	...	,, .	Holme-on-Spalding	1·35	...
Essex .	Chelmsford, County Lab	1·12	50	,, .	West Witton, Ivy Ho.	2·38	69
,, .	Lexden Hill House	1·08	...	,, .	Felixkirk, Mt. St. John	1·70	69
Suff .	Haughley House	1·21	...	,, .	Pickering, Hungate	1·45	58
,, .	Campsea Ashe	1·22	55	,, .	Scarborough	1·03	42
Norf .	Norwich, Eaton	...	...	,, .	Middlesbrough	1·42	67
,, .	Wells, Holkham Hall	1·52	71	,, .	Balderdale, Hury Res.	3·21	81
,, .	Swaffham, The Villa	1·57	63	*Durh* .	Ushaw College	1·01	40
Wilts .	Devizes, Highclere	1·58	59	*Nor* .	Newcastle, Town Moor	·74	31
,, .	Bishops Cannings	1·92	67	,, .	Bellingham, Highgreen	1·75	51
Dor .	Evershot, Melbury Ho.	3·81	89	,, .	Lilburn Tower Gdns.	·91	27
,, .	Creech Grange	2·95	72	*Cumb* .	Geltsdale	2·44	...
,, .	Shaftesbury, Abbey Ho.	1·79	55	,, .	Carlisle, Scaleby Hall	1·93	64
Devon .	Plymouth, The Hoe	2·81	77	,, .	Borrowdale, Seathwaite	10·00	78
,, .	Launceston, Werringt'n	3·45	...	,, .	Borrowdale, Moraine	8·57	...
,, .	Holne, Church Pk. Cott.	5·46	85	,, .	Keswick, High Hill	3·46	60
,, .	Cullompton	2·56	74	*West* .	Appleby, Castle Bank	2·22	67
,, .	Sidmouth, Sidmount	2·78	89	*Glam* .	Cardiff, Ely P. Stn.	2·31	55
,, .	Filleigh, Castle Hill	3·28	...	,, .	Treherbert, Tynywaun	8·36	...
,, .	Barnstaple, N. Dev. Ath	2·87	73	*Carm* .	Carmarthen Friary	3·69	74
,, .	Dartm'r, Cranmere Pool	6·00	..	*Pemb* .	Haverfordwest, School	3·93	78
Corn .	Redruth, Trewirgie	3·34	69	*Card* .	Aberystwyth	3·45	...
,, .	Penzance, Morrab Gdn.	2·75	60	,, .	Cardigan, County Sch.	3·10	...
,, .	St. Austell, Trevarna	3·12	63	*Brec* .	Crickhowell, Talymaes	2·80	...
Soms .	Chewton Mendip	3·57	83	*Rad* .	Birm W.W. Tyrmynydd	5·28	79
,, .	Long Ashton	2·02	64	*Mont* .	Lake Vyrnwy	4·96	89
,, .	Street, Millfield	2·80	101	*Denb* .	Llangynhafal	2·67	87
Glos .	Blockley	1·91	...	*Mer* .	Dolgelly, Bryntirion	5·20	87
,, .	Cirencester, Gwynfa	2·42	81	*Carn* .	Llandudno	2·69	87
Here .	Ross, Birchlea	1·43	56	,, .	Snowdon, L. Llydaw 9	15·25	...
,, .	Ledbury, Underdown	1·64	67	*Ang* .	Holyhead, Salt Island	3·50	85
Salop .	Church Stretton	2·56	87	,, .	Lligwy	3·27	...
,, .	Shifnal, Hatton Grange	1·99	83	***Isle of Man***			
Worc .	Ombersley, Holt Lock	1·32	58		**Douglas, Boro' Cem.**	**2·93**	**61**
War .	Birminghm, Edgbaston	2·06	87	***Guernsey***			
Leics .	Thornton Reservoir	2·26	100		**St. PeterP't. Grange Rd**	**2·60**	**62**

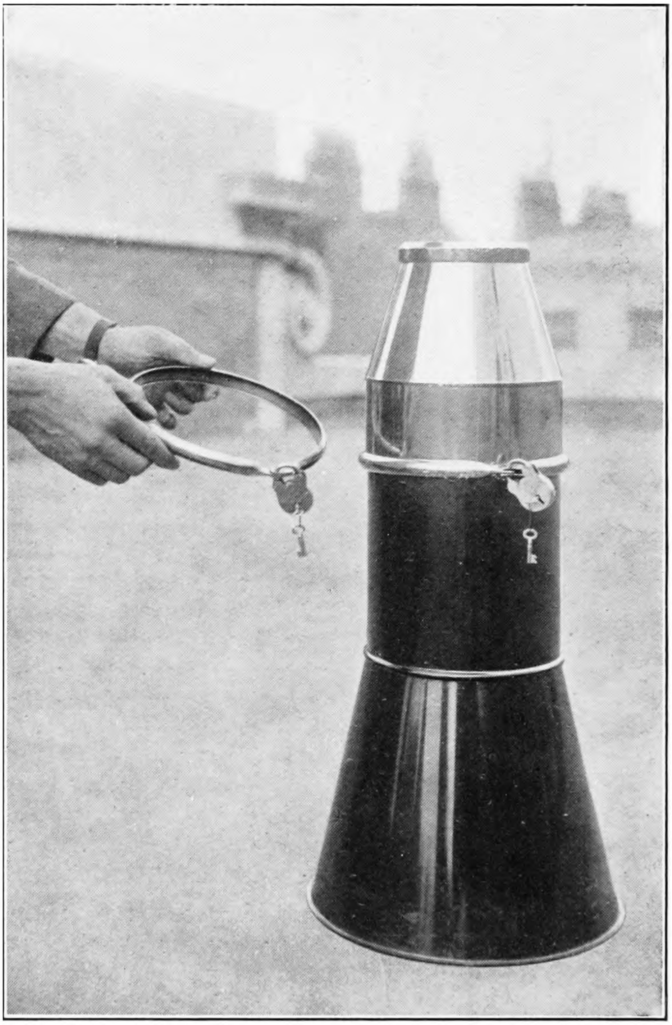
Rainfall: November, 1932: Scotland and Ireland.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt .	Pt. William, Monreith	2·88	67	*Suth* .	Melvich	3·73	...
,, .	New Luce School	4·36	65	,, .	Loch More, Achfary	8·44	99
Kirk .	Carsphairn, Shiel	7·94	100	*Caith* .	Wick	2·93	93
Dumf .	Dumfries, Crichton, R.I	2·65	76	*Ork* .	Pomona, Deerness	4·52	115
,, .	Eskdalemuir Obs.	5·55	96	*Shet* .	Lerwick	3·20	75
Roxb .	Branxholm	1·90	57	*Cork* .	Caheragh Rectory	2·35	...
Selk .	Ettrick Manse	4·31	79	,, .	Dunmanway Rectory	3·33	54
Peeb .	West Linton	2·97	...	,, .	Ballinacurra	1·68	42
Berw .	Marchmont House	1·19	40	,, .	Glanmire, Lota Lo.	1·88	44
E. Lot .	North Berwick Res.	1·49	67	*Kerry* .	Valentia Obsy	2·11	39
Midl .	Edinburgh, Roy. Obs.	1·56	70	,, .	Gearahameen	5·60	...
Lan .	Auchtyfardle	3·62	...	,, .	Killarney Asylum	2·43	43
Ayr .	Kilmarnock, Kay Pk.	...	...	,, .	Darrynane Abbey	2·15	42
,, .	Girvan, Pinmore	4·60	87	*Wat* .	Waterford, Gortmore	1·90	51
Renf .	Glasgow, Queen's Pk.	3·36	90	*Tip* .	Nenagh, Cas. Lough	2·26	56
,, .	Greenock, Prospect H.	7·25	113	,, .	Roscrea, Timoney Park	1·84	...
Bute .	Rothesay, Ardencraig.	5·13	...	,, .	Cashel, Ballinamona	1·73	49
,, .	Dougarie Lodge	3·11	...	*Lim* .	Foynes, Coolnanes	2·22	56
Arg .	Ardgour House	16·17	...	,, .	Castleconnel Rec.	2·59	...
,, .	Glen Etive	...	...	*Clare* .	Inagh, Mount Callan	3·90	...
,, .	Oban	7·01	127	,, .	Broadford, Hurdlest'n.	2·46	...
,, .	Poltalloch	5·85	105	*Wexf* .	Gorey, Courtown Ho.	1·49	43
,, .	Inveraray Castle	10·76	127	*Kilk* .	Kilkenny Castle	1·52	49
,, .	Islay, Eallabus	4·42	82	*Wick* .	Rathnew, Clonmannon	·80	...
,, .	Mull, Benmore	8·70	...	*Carl* .	Hacketstown Rectory	2·12	54
,, .	Tiree	5·01	104	*Leix* .	Blandsfort House	1·95	58
Kinr .	Loch Leven Sluice	1·93	54	,, .	Mountmellick	2·24	...
Perth .	Loch Dhu	8·50	98	*Offaly* .	Birr Castle	1·28	41
,, .	Balquhidder, Stronvar	5·75	...	*Kild'r* .	Monasterevin	1·91	...
,, .	Crieff, Strathearn Hyd.	2·43	56	*Dublin*	Dublin, FitzWm. Sq.	1·16	43
,, .	Blair Castle Gardens	2·49	71	,, .	Balbriggan, Ardgillan.	·99	34
Angus .	Kettins School	1·64	53	*Meath* .	Beauparc, St. Cloud	1·71	...
,, .	Dundee, E. Necropolis	1·31	54	,, .	Kells, Headfort	1·99	59
,, .	Pearsie House	2·14	...	*W. M* .	Moate, Coolatore	1·80	...
,, .	Montrose, Sunnyside	1·33	50	,, .	Mullingar, Belvedere	1·77	52
Aber .	Braemar, Bank	2·55	66	*Long* .	Castle Forbes Gdns.	2·58	72
,, .	Logie Coldstone Sch.	1·79	58	*Gal* .	Ballynahinch Castle	3·20	53
,, .	Aberdeen, King's Coll.	1·65	56	,, .	Galway, Grammar Sch.	1·98	...
,, .	Fyvie Castle	2·53	73	*Mayo* .	Mallaranny	5·44	...
Moray	Gordon Castle	3·09	107	,, .	Westport House	3·73	76
,, .	Grantown-on-Spey	...	...	,, .	Delphi Lodge	8·44	81
Nairn .	Nairn	2·77	117	*Sligo* .	Markree Obsy	3·27	77
Inv's .	Ben Alder Lodge	7·32	...	*Cavan* .	Belturbet, Cloverhill	1·79	58
,, .	Kingussie, The Birches	4·51	...	*Ferm* .	Enniskillen, Portora	2·80	...
,, .	Loch Quoich, Loan	20·10	...	*Arm* .	Armagh Obsy	2·04	72
,, .	Glenquoich	18·02	148	*Down* .	Fofanny Reservoir	2·44	...
,, .	Inverness, Culduthel R.	3·49	...	,, .	Seaforde	1·62	43
,, .	Arisaig, Faire-na-Squir	6·64	...	,, .	Donaghadee, C. Stn.	1·98	65
,, .	Fort William, Glasdrum	11·49	...	,, .	Banbridge, Milltown	1·31	48
,, .	Skye, Dunvegan	6·11	...	*Antr* .	Belfast, Cavehill Rd.	2·32	...
,, .	Barra, Skallary	4·74	...	,, .	Glenarm Castle	...	...
R & C .	Alness, Ardross Castle	4·38	109	,, .	Ballymena, Harryville	3·11	77
,, .	Ullapool	6·37	119	*Lon* .	Londonderry, Creggan	4·91	120
,, .	Achnashellach	10·96	120	*Tyr* .	Omagh, Edenfel	2·86	75
,, .	Stornoway	4·58	79	*Don* .	Malin Head	3·88	...
Suth .	Lairg	4·16	104	,, .	Dunfanaghy	4·20	...
,, .	Tongue	4·34	95	,, .	Killybegs, Rockmount.	4·62	73

Climatological Table for the British Empire, June, 1932

STATIONS	PRESSURE		TEMPERATURE									PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean	Relative Humidity	Mean Cloud Am'nt					
	Mean of Day M.S.L. mb.	Diff. from Normal mb.	Max. ° F.	Min. ° F.	Max. ° F.	Min. ° F.	½ max. and min. ° F.	Diff. from Normal ° F	Wet Bulb ° F.	%	0—10	Am'nt in.	Diff. from Normal in.	Days	Hours per day	Per-centage of possible
London, Kew Obsy.	1018·3	+ 1·6	79	42	67·5	50·9	59·2	0·0	51·8	78	6·4	0·26	— 1·89	5	7·0	43
Gibraltar	1016·7	— 0·7	82	57	76·4	60·1	68·3	— 2·2	59·4	81	3·3	0·56	+ 0·08	4	..	..
Malta	1015·8	+ 0·6	82	57	76·4	65·4	70·9	— 1·8	65·3	77	4·4	0·02	— 0·07	1	10·7	74
St. Helena	1017·1	+ 1·1	67	55	62·5	56·4	59·5	— 1·0	57·6	91	9·2	3·80	..	18	..	..
Sierra Leone	1013·5	+ 1·5	89	69	85·1	72·8	78·9	— 1·4	75·8	83	7·5	20·56	+ 0·52	20	..	..
Lagos, Nigeria	1012·8	+ 0·4	86	72	82·6	74·4	78·5	— 1·0	75·2	89	9·6	14·10	— 4·38	23	3·5	28
Kaduna, Nigeria	1013·7	— 0·1	91	65	86·8	69·2	78·0	+ 1·5	71·9	80	7·7	5·38	— 1·71	13	6·5	51
Zomba, Nyasaland	1016·7	— 0·8	79	46	73·8	51·3	62·5	— 0·4	..	73	4·5	0·26	— 0·22	1	..	..
Salisbury, Rhodesia	1021·7	— 0·2	73	37	69·3	43·0	56·1	— 0·8	49·0	51	2·9	0·00	— 0·05	0	7·8	70
Cape Town	1021·5	+ 1·4	78	40	62·6	50·6	56·6	+ 0·9	51·2	91	7·6	4·79	+ 0·29	15	..	..
Johannesburg	1021·6	0·0	69	28	61·2	42·2	51·7	+ 1·0	39·7	35	1·2	0·04	— 0·10	2	9·1	87
Mauritius	1019·1	+ 0·1	79	56	75·2	62·8	69·0	— 0·4	66·6	76	5·1	7·45	+ 4·65	21	6·7	61
Calcutta, Alipore Obsy.	998·7	— 1·0	98	75	91·4	80·3	85·9	+ 0·8	80·7	88	8·5	7·44	— 4·47	11*	..	..
Bombay	1005·2	+ 1·2	94	73	90·3	79·4	84·9	+ 0·9	78·1	79	6·6	10·62	— 9·25	14*	..	..
Madras	1003·9	+ 0·1	107	74	99·4	82·0	90·7	+ 0·7	75·2	56	5·5	1·14	— 0·83	3*	..	..
Colombo, Ceylon	1009·3	+ 0·7	86	74	85·4	78·3	81·9	+ 0·3	77·9	79	6·8	1·68	— 5·64	18	6·5	52
Singapore	1008·8	— 0·1	90	70	86·4	74·6	80·5	— 1·0	76·8	82	7·6	7·07	+ 0·20	15	5·4	44
Hongkong	1004·9	— 0·9	90	76	86·0	79·1	82·5	+ 1·1	78·9	83	9·0	25·29	+ 9·59	22	4·1	30
Sandakan	..	..	94	73	87·8	75·6	81·7	0·0	77·3	82	6·1	6·88	— 0·62	15	..	..
Sydney, N.S.W.	1015·9	— 2·0	74	36	63·0	46·0	54·5	— 0·2	47·9	74	5·0	1·13	— 3·61	6	6·1	62
Melbourne	1015·9	— 2·6	68	35	56·3	43·3	49·8	— 0·6	45·4	81	7·0	2·10	+ 0·04	19	3·2	33
Adelaide	1018·3	— 0·8	68	37	60·6	47·2	53·9	+ 0·4	49·4	76	5·5	4·48	+ 1·38	19	4·8	50
Perth, W. Australia	1018·3	+ 0·3	73	38	65·3	48·8	57·1	+ 0·3	51·2	74	5·6	6·47	— 0·47	16	5·8	58
Coolgardie	1019·9	+ 1·0	76	32	63·9	41·9	52·9	+ 0·1	45·9	68	3·2	0·39	— 0·87	4	..	..
Brisbane	1017·7	— 0·6	77	42	68·1	51·9	60·0	— 0·2	53·0	65	4·0	0·60	— 2·17	6	6·3	61
Hobart, Tasmania	1009·5	— 4·8	64	32	52·7	41·7	47·2	+ 0·2	42·8	77	6·3	2·48	+ 0·25	19	3·4	37
Wellington, N.Z.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Suva, Fiji	1013·5	— 0·1	87	65	80·9	70·1	75·5	+ 0·8	71·5	80	5·8	2·43	— 4·28	17	5·6	50
Apia, Samoa	1011·4	— 0·2	89	66	85·1	72·4	78·7	+ 0.9	75·3	76	3·7	1·31	— 4·04	7	8·0	71
Kingston, Jamaica	1012·4	— 1·4	91	71	88·3	74·2	81·3	0·0	73·9	79	6·9	3·09	— 1·01	9	4·6	35
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1012·3	— 2·4	83	43	75·7	57·0	66·3	+ 2·5	59·5	71	4·0	1·00	— 1·66	7	9·0	58
Winnipeg	1010·6	— 1·2	91	42	79·1	56·7	67·9	+ 5·6	58·6	75	5·3	2·91	— 0·20	11	9·3	57
St. John, N.B.	1010·6	— 2·9	81	38	63·7	47·4	55·5	— 1·0	52·1	81	5·9	3·65	+ 0·38	13	..	..
Victoria, B.C.	1016·9	+ 0·1	88	45	67·1	50·2	58·7	+ 1·7	53·4	71	3·8	0·91	+ 0·07	2	11·0	69

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.



THE LOCKING OF RAIN-GAUGE FUNNELS (see p. 289)

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The Weather of 1932—a Varied Year

The year 1932 as a whole has not been remarkable either for heat or cold, drought or heavy rain. Full details for December are not yet available, but it is safe to say that over south-eastern England and over the British Isles as a whole temperature was less than a degree above normal, sunshine definitely below normal and rainfall slightly below normal. Some of the individual months have, however, presented outstanding features. The vagaries of the rainfall are described more fully in another article,* and the following account deals mainly with the temperature, winds and general weather conditions.

In January a persistent anticyclone covered the western Mediterranean and France, and for the greater part of the month extended its influence over most of the British Isles. The eastern parts of Great Britain enjoyed a good month, fine, dry and mild, but in the west the persistent strong south-westerly winds brought very heavy rainfall, and there were several widespread and destructive gales. Over the country as a whole the temperature was nearly 5°F. above normal.

In the last week of January pressure rose to a very high level over the British Isles, and intense anticyclonic conditions were maintained during the whole of February. At Malin Head the mean pressure for the month was as high as 1035·7mb, the

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* *See* p. 275.

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highest monthly mean on record in these islands. The pressure distribution during this month was described and illustrated in the *Meteorological Magazine* for March, 1932. The weather was extremely dry; in Scotland it was mild and western Scotland enjoyed abundant sunshine, but southern England was dull and cold, with frequent fogs.

Anticyclonic conditions continued, but with greatly decreased intensity, during the greater part of March, which in the south was mainly fine and dry, with cold nights but moderately warm days. In the north the weather was dull, and eastern Scotland, owing to the prevalence of east winds, had an excess of rain. About March 20th there was a general fall of pressure and conditions were unsettled, cloudy and rainy throughout April. In the latter month the greatest deficit of pressure lay over southern Norway, and strong westerly winds predominated. The air supply was mainly of polar origin, and temperatures were from 1°F. to 3°F. below normal. In the north ground frost was frequent, and there were many falls of snow, sleet and hail with local thunder.

In May an extensive trough of low pressure extended from mid-Atlantic across Ireland and England to the Baltic. Weather was again cool, dull and rainy, only two-thirds of the normal sunshine being recorded over the country as a whole, and little more than half over central and southern England. England was excessively wet, with more than twice the normal rainfall. On the last day of the month the weather changed completely; an anticyclone over Iceland spread south-eastward and on June 4th became established over the British Isles, to persist with few changes until the 24th. June was as remarkable for dryness as May was for heavy rain, and in most districts the month was sunny. Temperature was high in the west, but owing to the frequency of light north-easterly winds the east of Great Britain was cooler than normal.

Once again the weather changed almost exactly at the end of the month, heavy rain setting in on the night of June 30th, and July was mainly dull and wet. Pressure was everywhere from two to four millibars below normal, and in an unstable westerly current widespread thunderstorms were frequent. Temperatures were for the most part moderate, but a hot spell from the 9th to 12th gave readings exceeding 80°F. in the east and Midlands, and reaching 86°F. in London on the 10th and 11th.

Unsettled and thundery conditions continued into the beginning of August, but on the 4th an anticyclone spread over the country and maintained its position for the greater part of the month, giving pressures 3 to 5mb. above normal. Weather was fine and exceptionally warm, but there were a number of severe local thunderstorms which caused the distribution of rainfall to be very irregular. August 11th and 19th were notably warm; on the latter day temperatures exceeded 90°F. in many parts of southern England and the Midlands and reached 97°F. at Halstead in Essex and in several parts of London. At Camden Square this was the highest temperature registered since records began 74 years ago. A thermometer in the Glaisher Stand at Greenwich recorded 99°F., one degree lower than the famous maximum of August 9th, 1911. The month as a whole was 4·2°F. above normal in south-east England, and nearly 3°F. above normal over the country as a whole. Towards the end of August conditions became unsettled, and in September there was again a reversal. Pressure was more than 10mb. below normal over northern Norway and the low pressure extended over the British Isles, giving stormy westerly winds with dull weather and heavy rain. Temperatures were generally moderate, but there were two warm spells, from the 1st to 2nd and from the 14th to 17th; during the latter a temperature of 81°F. was recorded at Birmingham. Stormy conditions continued during October with a somewhat similar pressure distribution, but early in November pressure rose generally and the weather became drier and more settled. The most remarkable feature of the latter month, however, was the absence of sunshine, which at many places amounted to less than an hour a day. Only once (in 1888) since records began in 1880 has the total fallen short of the figure of 26 hours recorded at Kew Observatory. Fog was frequent, but temperatures were not abnormal. December was on the whole unusually mild and in most districts showed totals of sunshine above the average; in England and northern Scotland there was a large deficiency of rainfall. Easterly winds and low temperatures prevailed from the 6th to 11th, and in the western English Channel easterly gales occurred from 6th to 10th, but after the 12th mild south to south-west winds prevailed over most of the country.

The Rainfall of 1932

Perhaps more than usual interest was taken in the rainfall of 1932. Would it add yet another to the run of nine wet years, or would the sequence be broken at last? The general rainfall of 1932 approximated closely to the average in all countries, the provisional general percentages of the average, 1881 to 1915, being:—England and Wales 102, Scotland 106, Ireland 94, and the British Isles 101. The popular impression is that 1932 was a dry year, but it is only dry in comparison with the totals recorded during the last ten years. The total rainfall of 1932 was similar to that of 1929 and 1922, and it was most striking in Ireland, where it was the driest year since 1922. The rainfall in Ireland would have been much more more noteworthy but for the wet December. The general percentage values were much smaller for Ireland than for England and Wales and Scotland, in April, September and October, while neither Ireland nor Scotland were as wet as England and Wales during May.

General values for each month are set out in the table below, as percentages of the average for the period 1881 to 1915 :—

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	%	%	%	%	%	%	%	%	%	%	%	%
England and Wales ...	111	18	88	156	221	59	144	56	144	153	69	47
Scotland ...	150	12	101	160	108	49	121	54	137	169	86	112
Ireland ...	122	7	71	118	134	60	138	62	109	105	58	138
British Isles ...	123	14	88	149	174	57	137	57	135	148	71	81

The corresponding general values in actual inches of rainfall are given below :—

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
England and Wales...	3·3	0·5	2·3	3·3	5·1	1·4	4·1	1·9	3·7	6·1	2·4	1·8
Scotland ...	7·3	0·5	4·1	4·8	3·2	1·4	4·6	2·4	5·5	8·3	4·5	6·6
Ireland ...	5·0	0·3	2·4	3·2	3·7	1·7	4·6	2·6	3·4	4·3	2·5	6·9
British Isles...	4·6	0·5	2·8	3·8	4·5	1·5	4·4	2·2	4·2	6·3	3·0	3·8

The total rainfall over the British Isles during the winter half-year, October, 1931, to March, 1932, was 19·8 in. or 3·6 in. less than the average; that of the summer half-year, April to September, 1932, was 20·6 in. or 2·6 in. in excess of the average. It will be recalled that after about 1910 wet winters predominated, while of more recent years the excesses have been contributed mainly by wet summers. This was again the case in 1932.

During January there was a sharp contrast between the totals recorded in the west and in the east. More than twice the average fell in parts of Dartmoor, Cornwall and Sutherlandshire, while less than half the average occurred along parts of the east coast. As much as 34·7 in. was recorded on The Stye at the Head of Borrowdale, while the total at Tynemouth was only 0·58 in. The general rainfall over the British Isles during February was less than that recorded in any other month since comparable statistics became available in 1870. The rainfall of the six weeks January 21st to March 3rd was unusual in that while there was some rain everywhere in the British Isles, the amounts were small. The " spring " drought was experienced over an exceptionally large area, for at Keswick, in the English

Lake District, the total rainfall January 25th to March 3rd was only 0·06 in.; at Glenquoich, in the Western Highlands, for February 3rd to March 3rd only 0·44 in., and at Galway from January 25th to March 19th (54 days) only 0·54 in. Further details are given in an article on "The Spring Drought of 1932."*

The rainfall of March was noteworthy in Ireland, where the general fall was only 71 per cent. of the average. The rainfall of April was appreciably in excess of the average over England and Wales and over Scotland, but over Ireland the excesses were small. The rainfall of May was most remarkable over England and Wales, where the general fall amounted to 5·1 in. or 221 per cent. of the average, and May, 1932, probably ranks as the wettest May over that area during the last 160 years. The most striking rains occurred on the 1st, 2nd, 15th and from the 20th to 23rd, and the largest amounts occurred during the last period in the Midlands. The general rainfall over the catchment area of the River Don draining to Doncaster has been estimated at 0·64 in., 2·33 in., 0·48 in. and 0·16 in. for the four days 20th to 23rd respectively, a total of 3·61 in. immediately before the maximum flow. Captain J. C. A. Roseveare, in his paper on "Land Drainage in England and Wales" read before the Institution of Water Engineers, December, 1932, records that "water stood in the streets of Bentley for more than a month. Two collieries were directly affected by the floods, 33,000 manshifts being lost in a fortnight." Further details of the rainfall of May are given on pp. 119-21 of the June number of this magazine.

The rainfall of both June and August was appreciably less than the average, and the dry and warm periods during these months did much to create the popular impression of a good summer. Of the thunderstorm rains which occurred locally during July and August the most striking was that during the afternoon of July 11th at Cranwell Aerodrome, in Lincolnshire, when 4·96 in. was recorded in 120 minutes, of which 4·18 in. fell in 90 minutes. The rainfall of September was more variable than usual, some areas recording more than twice the average, while others received less than 80 per cent. October was the wettest month over the British Isles as a whole, and it was the wettest October since that of 1916. As in September and April the excesses were much less marked over Ireland than elsewhere. The rainfall of November was less than the average for the first time in seven years. The rainfall of December has been less than the average in most recent years, only one of the last eight receiving more than the average. In December, 1932, the rainfall was noteworthy for the marked contrast between that recorded in the east and west. At Camden Square (London) the total was only 0·47 in. At Rosthwaite in Borrowdale falls of 5·18 in. and 4·05 in. were recorded for the 16th and 17th respectively; while at Evan Water School, near Moffat in Dumfriesshire, the total for the six days December 14th to 19th amounted to 9·12 in.

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* *See Meteorological Magazine* 67, 1932, pp. 67-9.

In nearly all parts of the British Isles the total rainfall varied but little from the average, few stations reporting more than 120 per cent. or less than 85 per cent. In England and Wales less than 90 per cent. occurred near Brighton, Croydon, Enfield, Harpenden, Hull, Louth, Wakefield and along the east coast of Northumberland. More than 110 per cent. was recorded over Dartmoor, a large area between Swansea, Marlborough, Rugby and Shrewsbury, in the English Lake District and in parts of North Wales. Locally in these areas more than 120 per cent. was recorded. In Scotland less than 90 per cent. occurred in the extreme south-east and in the north-west. At both Stornoway in the Isle of Lewis, and Marchmont House, Berwickshire, there was 86 per cent. The largest percentage values occurred in the mountainous areas of the west and south-west, as much as 118 per cent. being recorded at Corran Lighthouse, to the south of Fort William, Inveraray Castle, Glasgow, Airdrie and New Cumnock, in Ayrshire. In Ireland the percentage values varied from about 85 per cent. in the south-west and west to rather more than 100 per cent. between Sligo and Omagh, and along the east coast.

J. GLASSPOOLE.

Anemometers and the Beaufort Scale of Wind Force

The question of the relationship between the force of the wind as estimated on the Beaufort Scale and the velocity of the wind as determined by an anemometer is one which has for long exercised the minds of meteorologists. Tentative scales of equivalents are to be found in early books of instructions, but we may take as a starting point for the present note the publication in 1906 of a meteorological report entitled "Beaufort Scale of Wind Force" (Official No. 180). This contains an account of an investigation by Dr. G. C Simpson which showed that for anemometers in open situations, with their vanes or cups at a height of about 10 metres (33 feet), the Beaufort number B was related to the wind velocity V, in miles per hour, by the equation $V = 1{\cdot}87\sqrt{B^3}$. Starting from this equation, two tables can be compiled. In one, by giving B the values 1, 2, 3, etc., in succession, the average value of the velocity equivalent to a given Beaufort number can be written down; in the other, by giving B the values ½, 1½, 2½, etc., in succession, the range of velocity covered by the Beaufort numbers 1, 2, 3, etc., can be stated, thus providing a means for converting a measured velocity into a Beaufort number. In this way the official tables of velocity equivalents of the Beaufort numbers printed on pages 42-3 of the *Observer's Handbook* and on pages 32-3 of the *Meteorological Glossary* were prepared.

Observant readers of the *Monthly Weather Report* may have noticed that in recent months changes have been made in the tables relating to wind. In Table II (Summary of Autographic Records of Wind) a column has appeared with the heading " Effective Height," and in the Notes on the back page it is explained that " the effective height is an estimate of the height at which an anemometer would record an equal mean velocity in a situation free from obstructions." Also in regard to Table IV (Summary of Observations at Fixed Hours) there is a note that " at stations where there are anemographs the mean velocity for a period of about 10 minutes is converted to " force " on the Beaufort Scale by means of a table of equivalents appropriate to the exposure." In other words, official recognition has been given to the principle that the nature of the exposure of the anemometer must be taken into account when converting velocity to Beaufort force. The adoption of this principle implies that a scale of Beaufort equivalents appropriate to any anemometer can be drawn up if we have three pieces of information (1) a scale of equivalents for a standard effective height, (2) a formula showing the variation of wind velocity with height in an open situation, and (3) the effective height of the particular anemometer under consideration.

As regards (3) the effective heights of British anemometers have been carefully estimated by taking into account the surroundings of the anemometers and such knowledge as is available of the effect of obstructions on the speed of the wind: *the effective height is always less than the actual height.* As regards (2) the formula for variation of velocity (V) with height (h) which has been adopted by the Meteorological Office is Hellmann's formula :—

$$V = K\left(1{\cdot}00 + 2{\cdot}81 \log (h + 4{\cdot}75)\right)$$

where K is constant, and h is in metres. The value of the constant need not concern us because the formula is only required for the purpose of giving the ratio of the velocity V_h at height h to the velocity V_1 at the standard height h_1. This ratio is equal to

$$\frac{1{\cdot}00 + 2{\cdot}81 \log (h + 4{\cdot}75)}{1{\cdot}00 + 2{\cdot}81 \log (h_1 + 4{\cdot}75)}$$

The standard height has been taken to be 10 metres (33 feet) and the standard equivalents adopted for that height are those found by G. C. Simpson, already referred to. In this way scales of Beaufort equivalents for any anemometer, the effective height of which is known, have been computed and are shown graphically in the diagram (fig. 1), where the upper and lower limits of each number on the Beaufort Scale are plotted as abscissæ with the effective height as ordinate. The broken line shows the value of the ratio $V_h/V_{10m.}$ To illustrate the effect of the change the scales are given below for the anemometers at Cardington (h=135ft.) and Aldergrove (h=20ft.), together with the standard scale (h=10 metres or 33ft.) formerly used at all stations.

Velocity Equivalents of Beaufort Numbers.
Limits of Velocity.

Beaufort Force.	*Cardington (h=135ft.) m.p.h.*	*Aldergrove (h=20ft.) m.p.h.*	*Standard Scale (h=33ft.) m.p.h.*
0	< 1	<1	< 1
1	1— 4	1— 3	1— 3
2	5— 9	4— 7	4— 7
3	10—16	8—11	8—12
4	17—23	12—16	13—18
5	24—32	17—22	19—24
6	33—41	23—28	25—31
7	42—50	29—35	32—38
8	51—61	36—42	39—46
9	62—72	43—50	47—54
10	73—84	51—58	55—63
11	85—99	59—69	64—75
12	over 99	over 69	over 75

It was decided to make no correction for height so long as the velocity computed from the formula does not differ by more than 5 per cent. from the standard value for a height of 10 metres; which is the case for anemometers having effective heights between 26 feet and 42 feet. The effective height of the majority of British anemometers is within these limits. In such cases the equivalents for a height of 10 metres have been retained; in all other cases the necessary allowance for height has been made since April 1st, 1932.

An important consequence of the change is that the number of " days of gale " printed in Table III of the *Monthly Weather Report* will tend to be reduced in the case of stations having high anemometers, and increased in the case of low anemometers. Hitherto anemometer stations have registered a day of gale when the " mean line " of the trace on the Dines instrument has reached a value of 39 m.p.h. or more at any time during the day. In future the occurrence of a gale will be determined by the lower limiting velocity corresponding to Force 8 as given in the table appropriate to the particular instrument. When the effective height lies between 26 and 42 feet, the limit of 39 m.p.h. will continue to apply. It should be noted that in Table II of the report the previous practice of summarising velocities shown by the anemograph has been continued; consequently, in the case of anemometers with equivalent height outside the limits 26 and 42 feet the figures for frequency of different categories of wind speed in that table are not to be regarded as figures for frequency of Beaufort numbers.

To complete this note it is necessary to record certain additional facts. In 1921 the International Meteorological Committee asked Dr. G. C. Simpson to consider the question of a definite scale of equivalents between the Beaufort numbers and wind velocity. His conclusions are given in a paper entitled "The Velocity Equivalents of the Beaufort Scale" (Meteorological Office Prof. Notes, No. 44). Dr. Simpson proposed the following "code scale" for telegraphing wind velocities measured by anemometers, no matter what their height or exposure :—

	Limits of Velocity.	
Code Number.	m/s.	m.p.h.
0	0— 0·5	0— 1
1	0·6— 1·7	2— 3
2	1·8— 3·3	4— 7
3	3·4— 5·2	8—11
4	5·3— 7·4	12—16
5	7·5— 9·8	17—21
6	9·9—12·4	22—27
7	12·5—15·2	28—33
8	15·3—18·2	34—40
9	18·3—21·5	41—48
10	21·6—25·1	49—56
11	25·2—29·0	57—65

He was careful to point out that there was no such thing as a unique scale of equivalents between wind velocity and Beaufort force. For that reason he held that a "code scale" should be adopted for synoptic purposes, the numbers of which would agree approximately with the Beaufort numbers in the case of anemometers not at abnormal heights, but that these should not be described as Beaufort numbers. In a footnote he added that the "code scale" might be regarded as roughly equivalent to a Beaufort force scale for an anemometer at a height of 6 metres.

Dr. Simpson's report came before the International Meteorological Committee at Vienna in 1926 which adopted Dr. Simpson's table as a definite scale of Beaufort equivalents for a height of 6 metres. (Resolution XXII.) Provision was made in the resolution for the application of appropriate corrections in determining the scale of equivalents for anemometers at other heights, but it was stated that the standard table should be used when such correction was less than 5 per cent. Taking 10 metres as the standard height for Meteorological Office anemometers, it was found that a scale computed for that height from the Vienna scale by Hellmann's formula agreed within 5 per cent. with the existing Meteorological Office scale. It was decided, therefore, to adhere to the Meteorological Office scale in the case of normally exposed anemometers in the British Isles, and to use it as the starting point in computing the scales

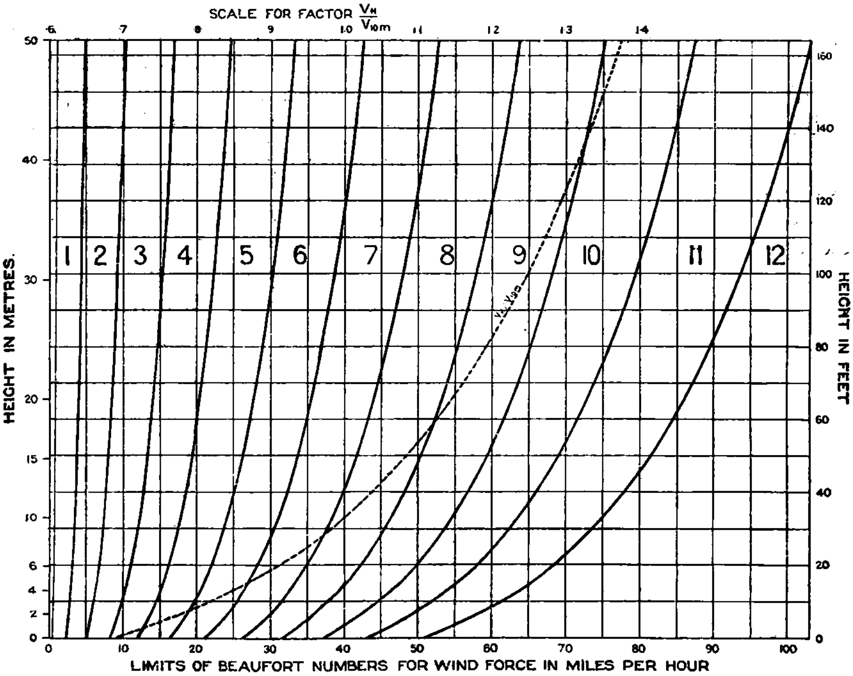

Fig. 1.

for abnormally exposed anemometers, an arrangement which involved the minimum amount of discontinuity in official wind statistics.

The conception of "effective height" is one about which controversy is almost inevitable, and it is perhaps advisable to explain a little more fully what is meant by the term. Suppose we set up two similar anemometers A and B on a wide level plain. Let A be erected on a slender mast to a height h, and suppose its recorder to be housed in an underground chamber so that the flow of air past the instrument is not disturbed in any way. Let B, on the other hand, be erected on the top of a building or among trees. Let the height of anemometer B be varied until the velocity it records agrees on the average with that recorded by A. Then the effective height of both anemometers will be the same. It may be denoted by h. In the case of A, h will be equal to the actual height above ground, but in the case of B it will be less than the actual height. It is realised that the two anemometers will not show the same average velocity on all occasions, because the effect of an obstacle varies with the wind structure. The use of the "effective height" which, in practice, can generally only be estimated, must therefore be regarded in the broad sense. The results obtained from conversion tables based on effective height will be, on the average, definitely more comparable than they were before. The ideal scheme of things demands that all anemometers should be exposed at a standard height in open situations, but practical considerations often necessitate a departure from this ideal. By using scales of equivalents based on effective height we aim at restoring estimates of Beaufort force based on measured velocities to uniformity, and it is probable that a high degree of uniformity will actually be obtained so far as mean values are concerned.

Discussions at the Meteorological Office

The subjects for discussion at the two next meetings will be:—

January 30th, 1933.—*The change in climate of a big town.* By L. Besson (Ann. Hygiène, Paris, 9, 1931, No. 8) (in French). *Opener.*—Mr. W. C. Kaye, B.Sc.

February 13th, 1933.—*Electron bombardment as a factor in atmospheric phenomena.* By W. M. Cohn (Beitr. Geophysik, Leipzig, 37, 1932, pp. 198-223) (in German).—*Opener.*—Dr. C. E. P. Brooks.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, December 14th, in the Society's Rooms, 49, Cromwell Road, South Kensington, Prof. S. Chapman, F.R.S., President, in the chair.

C. S. Durst, B.A.—The Thermal Balance of a water drop or ice particle suspended in the atmosphere.

From the examination of the long wave radiation received and given out by a water drop or ice particle, it is shown that such a particle will lose heat if it is above a certain critical temperature and gain heat if it is below, from which it follows that if a particle exists in the stratosphere it will gain heat. It is assumed that the base of the stratosphere is saturated and consideration is given to the conditions under which particles could be formed. It is found that if a small air mass were raised in the stratosphere the particles formed in it would be melted in a very short time and the temperature of the air would once more be that of its surroundings, the entropy of the air having been increased in the process.

Sir Gilbert T. Walker, C.S.I., Sc.D., F.R.S., and E. W. Bliss, M.A., M.Sc.—World Weather V. (Memoirs, Vol. 4, No. 36.)

In order to form more definite ideas regarding the North Atlantic, the North Pacific and the Southern oscillations, series of figures have been derived to express the variations of each, and from these have been obtained their relations with pressure, temperature, and rainfall over wide regions, as well as the relations of the three oscillations with each other and with sunspots.

The southern oscillation in the southern winter is found to be extremely persistent, and its departure has a correlation coefficient of ·84 with that of the following summer, thus providing a basis for foreshadowing seasonal conditions. The effects of Antarctic conditions and of ocean temperatures are considered, but a satisfactory physical basis for the oscillations has still to be found.

C. S. Durst, B.A.—The breakdown of steep wind gradients in inversions.

It is noticed on certain occasions when inversions have formed that a violent eddying arises, which is shown on an anemometer as an abrupt change in the type of trace. It is shown that this change over occurs when the wind gradient becomes great. On the ground that the eddies formed under these circumstances are different in character from those formed with an adiabatic temperature gradient a suggestion is put forward for the mechanism of the diurnal variation of wind.

Correspondence

To the Editor, *The Meteorological Magazine.*

The Colour of Moonlight

The following extract from Fleming's " Electric Lamps and Electric Lighting " bears on the question raised by Dr. Simpson in the November number of the *Meteorological Magazine.*

" On any bright moonlight night hold a white piece of card at the window, and place a candle so as to illuminate the card at about the same angle. Hold a pencil in front of the card and it will be seen that there are two shadows, one of which is a bright blue and the other a bright yellow. The yellow shadow is, apparently, the shadow thrown by the moon, and the blue shadow is, apparently, the shadow thrown by the candle."

I frequently observed, on bright moonlight nights in Malta brick red shadows of isolated street lamps, thrown by the moon on the grey limestone roadway; but the blueness of the shadows thrown by the lamps and illuminated by the moon was not so noticeable.

With regard to Mr. Bonacina's note that the sky lit by the full moon after twilight is occasionally conspicuously blue, may not Mr. Bilham's observation be applied to explain this? The night sky is not dead black. It is illuminated, and the colour of the illumination is clearly not red or green. Ordinarily the average person would, I believe, call it bluish grey—of the "Air Force blue" tint. Moreover, the colour of the moon varies from white to red according to the amount of scattering of its light by the atmosphere. Is it not likely, therefore, that occasionally in the conditions accompanying west winds, mentioned by Mr. Bonacina, the blue, and the blue only, is strongly scattered, with a consequent absence of blue from the moonlight entering the eye, and enhanced scattered blue illumination of the sky?

L. A. HARWOOD.

January 3rd, 1933.

In the December issue of the *Meteorological Magazine*, Mr. Bilham raises the question whether the brightness of the blue sky in full moonlight, due to Rayleigh scattering, is great enough to be visible as blue light. The question is answered by the following computation.

The brightness of the clear blue sky in full daylight is about 4,000 candles/sq. metre. Sunlight is roughly 400,000 times as bright as moonlight. Therefore the brightness of the clear blue sky in full moonlight is about 0·01 candles/sq. metre.

It appears from the data given by Walsh* that the lowest brightness at which the colour of blue can be recognised is below 0·02 candle/sq. metre. The brightness of the clear blue sky in full moonlight is apparently therefore of the same order of value as the colour threshold, and the blueness of the light might possibly be recognisable.

M. G. BENNETT.

Kew Observatory, Richmond, Surrey. December 29th, 1932.

Solar Phenomena observed at Hastings

I give below a few observations on a fairly complete halo system which occurred here on December 19th last, which I trust may prove of some interest.

The halo system was first noticed at 10h. 41m., when there was a beautifully coloured halo of 46°, together with an arc of contact of equal intensity. The colouring of the 46° halo was very striking, and gave the impression of a narrow rainbow; the red was situated inside or towards the sun, and other colours were visible, including the blue on the outside. The junction of the arc with the halo was bright and distinctly coloured. A sketch of the system when almost complete at 10h. 43m. is given. In addition to the 46° halo an ordinary 22° halo with parhelia and upper contact arc was also visible. The parhelion to the right of the sun was very bright, while that on the left was only just distinguishable; the upper contact arc of this halo was faint, except at the junction of the arc and halo. The extremity of this contact arc was curved downwards and was very faint and only remained visible for a short time. The whole phenomenon rapidly faded as cloud increased in density, and by 11h. only the upper contact arc of the 46° halo and the two parhelia were visible, the latter, however, remaining very distinct. At 11h. 35m. an indistinct corona and a parhelion to the left of the sun were observed.

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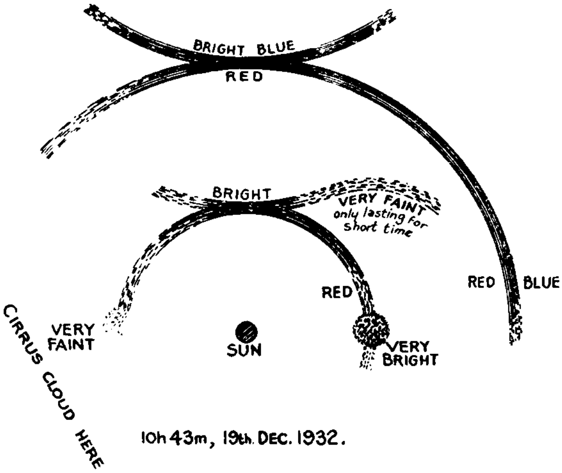
*See "Photometry," by Walsh. London, Constable & Co. Ltd., 1926.



10h 43m, 19th DEC. 1932.

The cloud in which the above phenomena was observed consisted of cirrus and cirro-stratus. The cirrus occurred in the lower left-hand region of the system and partly accounted for the incompleteness of the phenomena in that area. Cirro-stratus was responsible for the perfect formation of the remainder of the phenomena. The cloud was moving from the south-south-west with the surface wind at south, 15 to 20 m.p.h. As early as 8h. 55m. a parhelion was noticed to the right of the sun remaining visible for some time.

A. E. Moon.

39, *Clive Avenue, Clive Vale, Hastings. December 20th,* 1932.

The halo phenomena described below was seen here on the morning of December 19th. The 22° halo was poorly developed being fragmentary and feebly coloured, but there was an unusually large arc of the 46° halo present coloured prismatically, and also the fully developed and brilliant circumzenithal arc, which looked like a miniature rainbow. The halo was first noticed at 10h. 45m.; by 11h. it had practically disappeared.

Cicely M. Botley.

Guildables, 17, *Holmesdale Gardens, Hastings. December 19th,* 1932.

The Swan Song of the Radcliffe Observatory

In Mr. Bilham's review of the "swan song" of the Radcliffe Observatory* there is one criticism to which we think it important that we should make reference. He rightly points out that the hours at which the maximum and minimum thermometers were read were not the same throughout the fifty years 1881-1930; and that we omitted to state explicitly when the changes took place. This was indeed an oversight, and we should be grateful if you could allow us space not only to rectify the omission, but also to give some figures which may be useful in rendering the mean minimum temperatures, as published, more homogeneous.

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* *See Meteorological Magazine,* 67,1932, p. 191.

The figures printed for the mean maximum and minimum temperatures refer to the 24 hours ending at the hours shown in Table I for the different periods.

TABLE I

Period		*Terminal Hours*	
		Max.	*Min.*
1881-1888	... ...	8	12
1889-1914	... ...	20	20
1915-1924	... ...	21	21
1925-1930	... ...	9	9

For the years 1915-24 the thermometers were also read at 9h., and there is thus available (see Tables II and III) a means of

TABLE II.

DIFFERENCES OF MEAN MAXIMUM TEMPERATURE AT OXFORD.

(Terminal hour 9 *minus* terminal hour 21)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec.
1915	-°·1	-°·1	-°·3	°·0	°·0	°·0	°·0	-°·1	°·0	+°·1	-°·1	-°·1
1916	-·3	+·1	·0	+·2	-·1	+·1	·0	0	-·1	+·1	+·1	+·4
1917	-·5	-·1	-·1	+·1	·0	·0	-·1	·0	-·2	-·2	+·3	·0
1918	+·5	-·1	+·1	+·4	-·3	·0	·0	-·1	·0	-·2	·0	-·1
1919	+·4	+·2	·0	-·2	0	-·2	-·3	-·2	-·2	-·1	+·1	+·2
1920	+·1	-·4	-·1	·0	·0	-·1	+·2	·0	+·1	+·2	·0	+·5
1921	+·2	·0	·0	+·1	·0	-·1	·0	·0	·0	-·3	-·3	+·6
1922	+·2	-·3	·0	·0	-·2	-·2	·0	·0	+·2	+·1	+·8	+·2
1923	+·5	+·1	·0	-·1	+·1	+·3	+·1	·0	·0	+·3	·0	+·2
1924	+·2	-·5	+·2	+·1	·0	·0	·0	+·1	+·1	·0	·0	+·7
Mean	+·1	-·1	·0	+·1	·0	·0	·0	·0	·0	·0	+·1	+·3

TABLE III.

DIFFERENCES OF MEAN MINIMUM TEMPERATURE AT OXFORD.

(Terminal hour 9 *minus* terminal hour 21)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov.	Dec
1915	+°·1	-°·9	+°·1	+°·3	+°·3	°·0	+°·1	+°·2	+°·2	-°·8	°·0	-°·9
1916	+ ·3	- ·1	-·2	+·1	+·3	-·1	·0	+·1	+·4	·0	- ·2	-·6
1917	+ ·2	- ·9	-·6	·0	-·1	+·1	-·1	+·2	·0	·0	- ·9	-·5
1918	- ·6	- ·8	-·2	-·4	+·2	+·1	·0	·0	+·5	-·1	- .1	-·1
1919	- ·4	- ·4	+·2	+·1	·0	+·3	·0	+·2	+·2	-·2	- ·3	-·3
1920	-1·2	-1·4	-.5	+·1	+·1	+·1	·0	+·1	-·5	-·1	-1·2	-·4
1921	- ·4	- ·6	-·4	·0	+·1	·0	+·1	·0	+·5	-·2	- ·6	-·9
1922	- ·4	- ·5	+·3	+·1	+·1	+·2	+·2	+·1	·0	·0	-1·2	-·9
1923	- ·6	·0	-·3	-·3	+·4	+·2	+·1	+·1	+·1	+·1	- ·6	-·3
1924	- ·6	·0	-·2	-·1	+·1	+·1	·0	[illegible]	·0	-·3	- ·4	-·1
Mean	- ·4	- ·6	-·2	-·0	+·2	+·1	·0	+·1	+·1	-·2	-·6	-·5

reducing each individual monthly value during these years to the standard of 9h. as terminus, which may be thought desirable for the sake of comparison with other observations referred to this hour. We are, however, more concerned to reduce the whole series for the fifty years to a common standard, even though this can only be done in a statistical sense. The mean monthly differences in Table II are small enough to be neglected, and the figures, as printed, for the maximum temperature may be considered as sufficiently homogeneous. As regards the minimum temperature, the same is true for the two periods 1889-1914 and 1915-24. The mean values given in Table III (with signs changed) can be used to correct those of the fourth period to the standard of 21h. as terminus, and the same can be done approximately for the years 1881-88, when the minimum thermometer was read at 12h., by application of the differences in Table IV, which are derived from Kew hourly values for 1901-10, and have been kindly supplied by Mr. Bilham.

TABLE IV.—DIFFERENCES OF MEAN MINIMUM TEMPERATURE AT KEW (Terminal hour 21 *minus* terminal hour 12)

Month	*Difference*	*Month*	*Difference*	*Month*	*Difference*
January	—0·5	May	—0·1	September	—0·2
February	—0·3	June	—0·1	October	—0·5
March	—0·2	July	0·0	November	—0·6
April	—0·3	August	0·0	December	—0·6

H. KNOX-SHAW.
J. G. BALK.

Radcliffe Observatory, Oxford. *November* 30*th*, 1932.

Cloud Formation at the Cirrus Level by means of an Aeroplane

The formation of alto-cumulus by means of an aeroplane has been noted* on several occasions at this station. I am indebted to Flight-Lieut. White for an account of the formation of a cloud at a much higher altitude of 26,000 feet at about 15h. 30m. on October 27th, 1932. The ascent took the form of a steady climb in clear air throughout, the clouds present consisting of 3/10 of cumulus and 1/10 of alto-cumulus and cirrus. At a height of about 24,500 feet and a temperature of −45°F., the usual exhaust cloud began to form. Soon after, a dense stream of white solid-looking matter resembling the " steam " from a body taken out of a refrigerator appeared to originate at the nose of the machine, and came streaming over the wings. The cloud was far thicker than the usual exhaust cloud and totally obscured the pilot's view of the ground. About this time at a height of 26,000 feet (−51°F.) he first noticed the formation of ice on the windscreen and other parts of the machine, in particular the black nose had become white with hoarfrost. The cloud continued to form up to the ceiling of 27,000 feet (−56°F.) and also on the glide down until 25,000 feet (−47°F.) was reached, the engine being shut off in the latter stage. The ice accumulation did not disappear until a descent to 5,000 feet (35°F.) had been made. The cloud was not observed from the ground. Two further cases of the formation of cloud at these high altitudes have recently been brought to my notice, but unfortunately no details are available.

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* *Meteorological Magazines.* 66, 1931, *p.* 89, *and* 67, 1932, *p.* 139.

The description of the manner of formation of this cloud bears a strong resemblance to previous accounts of the formation of alto-cumulus by means of an aeroplane. The layer of formation about 2,000 feet or more is, however, deeper than that usually found in the case of alto-cumulus. The phenomenon of ice accretion would indicate that even at extremely low temperature it is still possible to meet water vapour.

W. H. BIGG.

Royal Aircraft Establishment, South Farnborough, Hants. *December 6th*, 1932.

NOTES AND QUERIES

A Warm Summer in 1778

The Countryman for July, 1932, contains a note by Mr. J. S. Ross describing a memorandum left by his great-great-grandfather, David Ross, born 1694, who farmed in Kincardineshire and lived to be over 80. The memorandum contains some interesting information about the state of crops in 1775 and 1778. Of the latter year he wrote : " In 1778 it was a bad seed time. But I never mind a warmer summer than it was. There was not a bad day from the tenth of May until the 9th and 10th of Oct$^{r.}$ Both of them Stormy wind and Rain from the north but the Stoucks (sheaves) were for leading (carting) in four Days."

The Locking of Rain-gauge Funnels

The Meteorological Office was recently asked to provide a means of locking the funnels on two mountain rain-gauges to prevent removal by unauthorised persons. After inquiry, it did not appear that there was any recognised existing method of doing this, and it was, therefore, necessary to devise a method *de novo*. The straightforward plan seemed to be to provide two hasps which could be soldered or riveted to the funnel and container of the gauge, provision being made for locking the two together by means of a padlock. The difficulty of fitting such hasps to a gauge which was already installed in a mountain site would, however, in general, be considerable. The device shown in the photograph which forms the frontispiece of this number of the magazine, which required no special fitting, was therefore evolved. A sufficient length of copper tube, 9/16 internal diameter, was procured and slit down its length to provide two pieces of semi-circular cross section. Each of these formed a locking device for one gauge. The half tube was bent into a circle of approximately the same diameter as the outside of the rain-gauge, and the two ends were shaped, one into a tongue and the other into a fork into which the tongue would readily slip. A hole drilled through both the fork and tongue permitted the attachment of a padlock. In use the ring is slipped over the two rims, the one on the funnel and the other on the container of the gauge, which butt against each other when the funnel is in position. The ring is then closed up and the padlock inserted. This prevents it being opened out sufficiently to permit of the funnel being withdrawn.

The gauges for which the fittings have been made are of the Octapent type, but a similar device could be used for any gauge where there are suitable rims on the funnel and container. The photograph shows a gauge with the ring and padlock in position, while a second ring detached from the gauge is shown on the left.

J. S. Dines.

Station at West Witton—Earth Thermometers for Disposal

We learn with much regret that Mr. J. B. Espiner, who has maintained a private climatological station at Ivy House, West Witton, Yorkshire, since 1910, has been compelled owing to ill-health to discontinue his observations other than those of rainfall. Representing the conditions 600 feet above sea level on the eastern slope of the Pennines, the West Witton observations were of more than ordinary interest. In addition to the usual readings, Mr. Espiner observed earth temperature at depths of 1 ft., 2 ft., and 4 ft. He wishes to dispose of the earth thermometers and anyone interested should communicate direct with Mr. Espiner at the address given above.

The Investigation of Cycles

A note* in the *Bulletin of the American Meteorological Society* describes briefly the proceedings at a meeting of a Committee of the National Academy of Sciences, Washington, formed to consider methods of studying cycles in natural phenomena. The discussion revealed that there are really two problems; the first is concerned with periodicities of a few days, months or years in length, many of which have been attributed to a solar origin.

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*A symposium on climatic cycles. *Worcester, Mass., Bull. Amer. Meteor. Soc. Vol.* 13, 1932. Nos. 6-7, p. 121.

These can be investigated by direct observation of the sun or of meteorological elements. The second deals with cycles of much greater length, and is found in records covering periods of thousands of years. Prominent among these are the measurements of annual tree-rings, and the " varves " or annual layers formed in the fluvio-glacial sediments of retreating ice-sheets. The tree-records extend back for a period of more than 3,000 years; the varves also cover a very long period but have not yet been dated precisely. The main need is now to correlate the tree-rings and the varves, a problem which calls for the joint efforts of archæologists, geologists and tree-ring experts.

Reviews

On discontinuous fluid motion under different thermal conditions. By S. K. Banerji and V. M. Ghatagei, Indian Journal of Physics, Vol. III, Part 3. Calcutta University Press.

There are many phenomena which can be interpreted as due to turbulence arising on the breaking down of steady motion between two masses of fluid. The mathematical treatment of such problems present almost insuperable difficulties; but experimental study, though requiring great care, is in general feasible, and the present paper is a very good example of such work. The authors first examine the nature of the eddies set up between two masses of liquid of different densities at rest when the vertical partition between them is removed; they trace the effects of varying the conditions and are thereby enabled to get insight into the principles involved. Then they consider the situation in which there is discontinuity in motion as well as in density, making photographs to show the motion of individual particles as well as of the masses of liquid. The conclusions drawn are numerous and interesting. It seems doubtful whether the authors are right in thinking that Bjerknes' theory of the production of cyclones as waves on the polar front is sufficiently plausible to provide a meteorological application; but the eddies set up by convection currents are of considerable importance to aeronauts and light thrown on the subject will have practical value apart from its purely scientific interest, which is considerable.

G. T. Walker.

Klima-Atlas für die Meeresheilkunde an der deutschen Seeküste. By Dr. C. Haeberlin and Dr. P. Perlewitz. Size 9¼ × 12½ in. Hamburg, 1932.

This atlas of 27 coloured charts has been compiled by a doctor of medicine and a well-known meteorologist in association, to assist in the utilisation of the German health and bathing resorts. Each chart is accompanied by a succinct explanation, and the whole forms a useful work of reference. The atlas opens with charts of air temperature over Germany in July and January reduced to mean sea level; unreduced temperatures would have been more useful but are difficult to map. The third chart, however, shows the average duration of actual temperatures below 0°C. and brings out clearly the effect of the Atlantic in tempering the continental winter. Other charts of medical importance show the frequency of oscillations of temperature about the freezing point, the distribution of hot days, frosts and " ice-days " and the annual range of temperature. Two charts show the " continentality " of Germany and Europe; these are followed by a series dealing with pressure, winds, ocean currents and salinity. Rainfall is but little represented, presumably because the information is readily obtainable elsewhere, but curves of sunshine and ultra-violet radiation are given for Hamburg and Sahlenburg, under the heading of " optical climate." The last few charts illustrate the effect of climate on vegetation. The whole combines a large amount of not very accessible material in a handy form; the charts are clear and striking; in fact, some of them are almost too striking in the brilliance of their colouring. The price, 3M., is remarkably low.

Osiris and the Atom. By J. G. Crowther. Size 7½ × 5 in., pp. viii + 221. *Illus.* London (Routledge), 1932. Price 5s.

Mr. Crowther is a scientific journalist and he has managed to compress into this little book an astounding variety of information on all sorts of topics from atomic physics to twins. The various sections are all most readable, and most of them, so far as the reviewer's limited knowledge goes, are reasonably accurate. The author has travelled widely in search of his material, and has talked with many interesting people. Osiris comes into the picture as one of the protagonists in a contest between life and death for the possession of a mummified Egyptian, supposed to be the origin of ball games, which in turn provide illustrations of atomic structure.

There are two chapters of special interest to meteorologists. The first deals with the great Siberian meteor, and is illustrated by reproductions of micro-barograms from England and by photographs of the devastated area. The account of the fallen trees, with a ring of upright trees among them indicating a " node " in the air-waves, is very good. The other meteorological section dealing with the causes of Thames floods is marred by a curious error, the normal atmospheric pressure at sea level being stated as 28 inches of mercury. There is also a section on " Cosmics," which includes an account of theories of the earth's magnetism and a well-informed and restrained discussion of the possibility, or rather impossibility, of exploring space. "Osiris and the Atom" can be recommended as a pleasant book for holiday reading.

Winds, weather and currents on the coasts of India and the laws of storms.—India Meteor. Dept. Size 9½ by 6 in., pp. 51, *Illus.* Calcutta, 1931. 4s. 3d.

The first part of the text is devoted to a short general account of the monsoons and land and sea breezes, followed by more detailed descriptions of the local meteorology of the various coastal regions, and an account of currents and tides. The recorded storm tracks are shown on a series of maps for various months. The remaining chapters deal with the "laws of storms" and rules for handling ships, and the system of visual signals for storm warnings at Indian ports, while a short appendix deals with navigation in the Bay of Bengal. A few minor misprints have been noted, but on the whole this pamphlet is a most useful and interesting summary. Not the least interesting section is the preface, which informs us that the information has been compiled in the Marine Section of the Poona Meteorological Office to meet the need of "a text-book to enable Indian seamen to study the laws of storms and the prevailing winds, weather and currents in Indian waters"—but what really brought matters to a head was apparently that in 1928 the Government of India "amended the rules for examination of candidates for certificates of competency as Masters and Mates of Steamships." Meteorologists, as well as those for whom this summary of conditions in India is intended, will find it useful.

S. T. A. MIRRLEES.

Apia Observatory, Samoa, Annual Report for 1930. Size 9¾ × 6 in., pp. iv + 71. Wellington, 1932.

This is the first report issued by the Apia Observatory since Mr. J. Wadsworth became Director on September 1st, 1930, in succession to Mr. A. Thomson. The report maintains its usual high standard, and provides a mass of valuable geophysical data which increases in importance with every year added to its already long series.

Books Received

Jaarboek, Koninklijk Nederlandsch Meteorologisch Instituut, 1930. A. Meteorologie, B. Aard-Magnetisme (Nos. 97 and 98). Utrecht, 1931.

Ergebnisse Aerologischer Beobachtungen, 1930. K. Ned. Meteor. Inst. (No. 106A). Utrecht, 1931.

Onweders, optische verschijnselen, enz. in Nederland. Naar vrijwillige waarnemingen in 1929. Deel 1, Amsterdam, 1931.

Obituary

Prof. Dr. A. Wigand.—We regret to learn of the death of Dr. A. Wigand, on December 18th, after a severe operation. Dr. Wigand was born at Kassel on October 12th, 1882, and was educated at Munich and at Marburg, where he took the degree of Ph.D. in 1905. He became an assistant in the Physical Institute at Marburg, and also taught at Dresden and in the University of Halle, where he was appointed Professor in 1917. At the time of his death he was Chief of the Section of Aerology, Meteorological Instruments and Research at the Deutsche Seewarte, Hamburg.

Dr. Wigand worked at first in the domain of pure physics, and especially on the physics of gases. These studies speedily found applications to the physics of the atmosphere, and he contributed a great number of meteorological papers to scientific journals. He was most interested in visibility and fog, and especially in the coagulation of water particles to form raindrops, which he studied both theoretically and by actual observation. In 1919 he invented a visibility meter. He also studied the distribution of condensation nuclei in the free atmosphere, the electrical conductivity in the upper air, and the neutral point of polarisation. In 1929, in association with Dr. August Schmauss, he wrote a remarkable book on " The Atmósphere as a Colloid," which aroused great interest; this book was reviewed in the *Meteorological Magazine* for 1929, p. 193. His last paper, " Experimental and theoretical studies on the coagulation of non-homogeneous fogs," appeared in the *Annalen der Hydrographie* for January, 1932.

News in Brief

As a result of the damage caused by the volcanic eruption of Mont Pelé in 1929, authority has been given for the establishment of a geophysical observatory on the island of Martinique in the West Indies. The main purpose of the observatory will be the study of vulcanology, but hurricane warnings will also be issued.

The annual meeting of the British Association for 1933 will be held in Leicester on September 6th-13th. Sir Gilbert Walker, Professor of Meteorology in the University of London, has been appointed president of Section A (Mathematical and Physical Sciences).

The Cambridge Philosophical Society has awarded the Hopkins prize for the period 1924-7 to Professor G. I. Taylor, Yarrow research professor of the Royal Society, for his researches on hydro-dynamics and on the de-formation of crystals.

Erratum

December, 1932, page 263, line 27, *for* " Mr. Kidson " read " Dr. Kidson."

The Weather of December, 1932

Pressure was above normal over southern Alaska, western Canada, the extreme western United States, the eastern United States, the St. Lawrence Region, Newfoundland, western North Atlantic, northern Africa and Europe, except for the extreme north and south-west, the greatest excesses being 10·4mb. at Prague and Lemberg, 6·1mb. at Juneau, and 4·0mb. at 50°N.50°W. Pressure was below normal over the central regions of Canada and the United States, Greenland, Spitsbergen, Iceland, eastern North Atlantic, south-west France, the western Iberian Peninsula, extreme northern Scandinavia and northern Russia. Temperature was above normal over the whole of western Europe, being as much as 13°F. above normal at Spitsbergen and between 11°F. and 14°F. in northern Sweden. Rainfall was mainly below normal, with 62mm. below normal at Zürich, and only 30 per cent. of the normal in southern and eastern Gothaland.

The outstanding feature of the weather of December over the British Isles was its unusual mildness except during a short period from the 6th-11th. The mean temperature for the month was 3·4°F. above normal at Aberdeen, 2·5°F. at Kew and 1·1°F. at Valentia. Sunshine was generally abundant except in the south-west of England, while rainfall was largely deficient in England and north Scotland but much above normal in Ireland and south Scotland; at Eskdalemuir it was the wettest December since records started there in 1910. The first day of the month was mild and sunny, but the weather became overcast and wet on the 2nd. On the 3rd and 4th northerly winds in the rear of the depression were associated with slight hail, sleet and snow in Scotland, north Ireland and the Midlands, but both days were generally sunny with 6·4 hrs. at Gorleston on the 3rd and 7·4 hrs. at Calshot on the 4th. Thunderstorms also occurred at Eskdalemuir and Aldergrove on the 3rd. On the 5th anticyclonic conditions developed over most of the British Isles and persisted until the 11th, but the south-west of Ireland and south-west England came under the influence of the depression centred off Portugal and easterly gales occurred frequently in the western English Channel from the 6th-11th. Temperature was low during this time, a maximum of 25°F. was recorded at Renfrew on the 6th, and of 26°F. at Dalwhinnie on the 8th, while even in Ireland maxima were generally below 45°F. The lowest minimum temperatures reported were 12°F. in the screen at Dalwhinnie on the 8th and 8°F. on the ground at Dalwhinnie on the 8th and 10th and 11°F. on the ground at Renfrew on the 7th. Slight sleet fell occasionally in the south and Midlands. As the anticyclone moved away eastwards conditions became progressively milder with widespread fog on the 13th. For the remainder of the month deep depressions moving across the North Atlantic influenced our weather, giving southerly or south-westerly winds generally with gales in the west and north on the 15th-17th, 23rd-24th, 29th and 31st. At Lerwick a gust of 94 m.p.h. was recorded on the 17th. Temperature was high for the time of year, reaching 61°F. at Dublin on the 17th and 60°F. at Dublin and Llandudno on the 18th. On many days temperature during the day was higher in Scotland and north England than in the south. Night minima, too, were high, reaching 54°F. at Dublin and 53°F. at Durham, Valentia, Southport, Sealand and Liverpool on the 18th. Rainfall was heavy in the north and west from the 16th to 20th, at Rosthwaite, Borrowdale, 5·18 in. fell on the 16th and 4·05 in. on the 17th, at Eskdalemuir 3·14 in., on the 16th, 2·20 in. on the 17th and 1·77 in. on the 18th and at Fofanny (Co. Down) 2·27 in. on the 19th. Much sunshine was experienced locally from the 20th to 25th. Christmas Day was very sunny and mild over most of the country, 6·6 hrs. of bright sunshine were recorded at Rhyl, 6·5 hrs. at the Scilly Isles and Aberystwyth, 6·3 hrs. at Birmingham, 5·6 hrs. at Clacton and Brighton and 5·5 hrs. at Durham and Auchincruive. Inland in south-east England, however, there was much mist or fog and this spread over most of the country on the 26th, but cleared somewhat on the 27th and 28th. On the 31st another deep depression approached the western coasts bringing gales to west Scotland, Ireland and the western English Channel. A gust of 96 m.p.h. was recorded at Valentia at 4h. 35m. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	32	+ 9	Liverpool	44	+ 1
Aberdeen	39	+ 3	Ross-on-Wye	56	+14
Dublin	49	+ 1	Falmouth	40	—15
Birr Castle	50	+ 7	Gorleston	51	+ 6
Valentia	51	+10	Kew	49	+12

The special message from Brazil states that the rainfall was scarce in the northern regions with 1·54 in. below normal, irregular in the central regions with 0.08 in. below normal, and generally abundant in the southern regions with 2·01 in. below normal. Eight anticyclones passed across the country. The crops generally were in good condition except the corn. At Rio de Janeiro pressure was 0·5mb. below normal and temperature 2·5°F. above normal.

Miscellaneous notes on weather abroad culled from various sources. Snow fell generally in Switzerland early in the month so that by the 12th there was nearly a foot of snow over the whole country. A heavy fall of snow was also reported over a wide area in the Lyons district on the 9th. Torrential rain about the 11th caused the Douro and Tagus to overflow, and parts of Oporto and the country round Santarem were flooded. On the 15th and 29th, Azov, Kherson and Nicolaieff were reported free of ice, and there was floating ice up to Kronstadt on the 15th. Owing to heavy rain part of a cliff at Alcala on the Jucar River, Spain, gave way on the 14th, and 10 villagers were killed. Heavy rain caused floods and damage to the crops and railways in the Perpignan district and in Catalonia about the 16th-18th. Navigation closed at Yxpila, Jacobstad, Vasa, Kristinestad and Kasko on the 21st. There was a small snowfall on the 27th in western Switzerland. Snow began to fall again in Switzerland on the 29th (*The Times*, December 7th-30th).

The Japanese destroyer *Sawarabi* foundered in a storm off Formosa on the 6th; 106 of her crew are missing. The long drought from which the Punjab was suffering was broken on the 21st with heavy rain in the plains and snow on the hills. Snow fell in Rawalpindi on the 29th, which is uncommon. Much welcome rain fell in central and southern Arabia during the month (*The Times*, December 6th-31st).

A storm in the Rockhampton district of Queensland about the 9th overturned a train and 15 passengers were injured. Heavy rain fell in Queensland from the 10th-13th, and in western Australia from the 17th-20th (*The Times*, December 10th and *Rainfall of Australia*).

Navigation in Montreal harbour closed for the winter months on the 7th and in Quebec on the 22nd. Abnormally severe cold was experienced in Canada in the first part of the month −48°F. was reported from White River in northern Ontario on the 9th and from Doucet (Quebec) on the 16th, but on Christmas Day there was an abnormally rapid thaw in eastern Canada. Temperature was above normal over the United States during the first few days, but subsequently an intensely cold wave spread across the country, the mean temperature for the week ending the 13th was 36°F below normal at Yellowstone Park and Lander. Rainfall was below normal during the first three weeks except in parts of the south-east States. Gales were encountered on the North Atlantic on the 14th, 15th, 20th and 27th-31st (*The Times*, December 19th-29th, and *Washington, D.C., U.S. Dept. Agric. Daily Weather Map and Weekly Weather and Crop Bulletin*).

Rainfall, 1932—General Distribution

	Dec.	Year.
England and Wales ...	47	102
Scotland	112	106
Ireland	138	94
British Isles	81	101

per cent of the average 1881-1915.

Rainfall: December, 1932: England and Wales.

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Lond	Camden Square	·47	20	*Leics*	Belvoir Castle	·68	28
Sur	Reigate, Alvington	·67	21	*Rut*	Ridlington	·65	26
Kent	Tenterden, Ashenden	·42	14	*Lincs*	Boston, Skirbeck	·67	31
,,	Folkestone, Boro. San.	·54	...	,,	Cranwell Aerodrome	·55	25
,,	Margate, Cliftonville	·35	15	,,	Skegness, Marine Gdns	·46	21
,,	Sevenoaks, Speldhurst	·61	...	,,	Louth, Westgate	·99	35
Sus	Patching Farm	1·13	34	,,	Brigg, Wrawby St.	1·12	...
,,	Brighton, Old Steyne	·60	19	*Notts*	Worksop, Hodsock	·68	29
,,	Heathfield, Barklye	·99	27	*Derby*	Derby, L. M. & S. Rly.	·55	21
Hants	Ventnor, Roy. Nat. Hos.	1·45	44	,,	Buxton, Devon Hos.	2·00	35
,,	Fordingbridge, Oaklnds	1·69	43	*Ches*	Runcorn, Weston Pt.	1·25	40
,,	Ovington Rectory	1·47	37	,,	Nantwich, Dorfold Hall	1·03	...
,,	Sherborne St. John	·88	27	*Lancs*	Manchester, Whit Pk.	1·12	35
Berks	Wellington College	·53	18	,,	Stonyhurst College	2·27	47
,,	Newbury, Greenham	1·14	36	,,	Southport, Hesketh Pk	1·64	51
Herts	Welwyn Garden City	·55	...	,,	Lancaster, Strathspey	2·98	...
Bucks	H. Wycombe, Flackwell	·65	...	*Yorks*	Wath-upon-Dearne	·72	30
Oxf	Oxford, Mag. College	·70	30	,,	Bradford, Lister Pk.	1·47	39
Nor	Pitsford, Sedgebrook	·99	41	,,	Oughtershaw Hall	5·00	...
,,	Oundle	·35	...	,,	Wetherby, Ribston H.	1·13	46
Beds	Woburn, Crawley Mill	·48	23	,,	Hull, Pearson Park	·91	38
Cam	Cambridge, Bot. Gdns.	·28	15	,,	Holme-on-Spalding	1·43	...
Essex	Chelmsford, County Lab	·33	15	,,	West Witton, Ivy Ho.	2·37	65
,,	Lexden Hill House	·25	...	,,	Felixkirk, Mt. St. John	1·14	47
Suff	Haughley House	·39	...	,,	Pickering, Hungate	1·41	56
,,	Campsea Ashe	·54	23	,,	Scarborough	·92	39
Norf	Norwich, Eaton	...	...	,,	Middlesbrough	87	45
,,	Wells, Holkham Hall	·52	25	,,	Balderdale, Hury Res.	2·40	65
,,	Swaffham, The Villa	·94	38	*Durh*	Ushaw College	1·22	49
Wilts	Devizes, Highclere	1·07	35	*Nor*	Newcastle, Town Moor	·69	29
,,	Bishops Cannings	1·10	34	,,	Bellingham, Highgreen	3·25	89
Dor	Evershot, Melbury Ho.	2·64	51	,,	Lilburn Tower Gdns.	1·64	62
,,	Creech Grange	1·77	40	*Cumb*	Geltsdale	1·91	...
,,	Shaftesbury, Abbey Ho.	1·56	43	,,	Carlisle, Scaleby Hall	2·58	80
Devon	Plymouth, The Hoe	3·77	75	,,	Borrowdale, Seathwaite	27·25	177
,,	Launceston, Werringt'n	4·56	...	,,	Borrowdale, Moraine	21·59	...
,,	Holne, Church Pk. Cott.	5·98	71	,,	Keswick, High Hill	9·51	142
,,	Cullompton	3·04	69	*West*	Appleby, Castle Bank	4·73	119
,,	Sidmouth, Sidmount	2·40	61	*Glam*	Cardiff, Ely P. Stn.	2·13	41
,,	Filleigh, Castle Hill	2·73	...	,,	Treherbert, Tynywaun	6·76	...
,,	Barnstaple, N. Dev. Ath	2·50	56	*Carm*	Carmarthen Friary	4·35	76
,,	Dartm'r, Cranmere Pool	6·00	...	*Pemb*	Haverfordwest, School	4·45	78
Corn	Redruth, Trewirgie	4·01	64	*Card*	Aberystwyth	2·81	...
,,	Penzance, Morrab Gdn.	3·28	58	,,	Cardigan, County Sch.	4·53	...
,,	St. Austell, Trevarna	3·73	61	*Brec*	Crickhowell, Talymaes	3·00	...
Soms	Chewton Mendip	2·88	54	*Rad*	Birm W. W. Tyrmynydd	4·32	53
,,	Long Ashton	1·60	41	*Mont*	Lake Vyrnwy	3·37	49
,,	Street, Millfield	1·81	53	*Denb*	Llangynhafal	1·43	43
Glos	Blockley	·87	...	*Mer*	Dolgelly, Bryntirion	4·35	43
,,	Cirencester, Gwynfa	·93	28	*Carn*	Llandudno	2·10	68
Here	Ross, Birchlea	1·75	59	,,	Snowdon, L. Llydaw 9	17·45	...
,,	Ledbury, Underdown	1·29	46	*Ang*	Holyhead, Salt Island	4·34	104
Salop	Church Stretton	1·76	52	,,	Lligwy	4·26	...
,	Shifnal, Hatton Grange	·95	37	*Isle of Man*			
Worc	Ombersley, Holt Lock	1·04	40		Douglas, Boro' Cem.	5·73	114
War	Birminghm, Edgbaston	1·07	40	*Guernsey*			
Leics	Thornton Reservoir	·71	26		St. Peter P't. Grange Rd	1·72	42

Rainfall: December, 1932: Scotland and Ireland.

Co.	STATION	In.	Per-cent. of Av.	Co.	STATION	In.	Per-cent. of Av.
Wigt .	Pt. William, Monreith	5·45	120	*Suth* .	Melvich	1·95	...
,, .	New Luce School	5·68	102	,, .	Loch More, Achfary	6·17	67
Kirk .	Carsphairn, Shiel	16·83	181	*Caith* .	Wick	2·01	65
Dumf .	Dumfries, Crichton, R.I	7·19	178	*Ork* .	Pomona, Deerness	2·73	65
,, .	Eskdalemuir Obs.	13·37	191	*Shet* .	Lerwick	2·59	54
Roxb .	Branxholm	5·47	150	*Cork* .	Caheragh Rectory	7·96	...
Selk .	Ettrick Manse	12·79	207	,, .	Dunmanway Rectory	10·50	131
Peeb .	West Linton	6·50	...	,, .	Ballinacurra	7·35	143
Berw .	Marchmont House	1·81	64	,, .	Glanmire, Lota Lo.	8·04	146
E. Lot .	North Berwick Res.	2·34	109	*Kerry* .	Valentia Obsy	8·22	124
Midl .	Edinburgh, Roy. Obs.	4·80	205	,, .	Gearahameen	19·10	...
Lan .	Auchtyfardle	8·09	...	,, .	Killarney Asylum	8·83	121
Ayr .	Kilmarnock, Kay Pk.	7·22	...	,, .	Darrynane Abbey	7·59	129
,, .	Girvan, Pinmore	8·38	140	*Wat* .	Waterford, Gortmore	8·02	175
Renf .	Glasgow, Queen's Pk.	8·34	187	*Tip* .	Nenagh, Cas. Lough	5·96	129
,, .	Greenock, Prospect H.	12·21	155	,, .	Roscrea, Timoney Park	4·76	...
Bute .	Rothesay, Ardencraig.	7·27	...	,, .	Cashel, Ballinamona	6·13	141
,, .	Dougarie Lodge	6·68	...	*Lim* .	Foynes, Coolnanes	5·19	110
Arg .	Ardgour House	14·66	...	,, ,	Castleconnel Rec.	4·83	...
,, .	Glen Etive	16·57	134	*Clare* .	Inagh, Mount Callan	7·60	...
,, .	Oban	7·04	104	,, .	Broadford, Hurdlest'n.	5·82	...
,, .	Poltalloch	7·15	113	*Wexf* .	Gorey, Courtown Ho.	7·49	196
,, .	Inveraray Castle	14·50	146	*Kilk* .	Kilkenny Castle	4·54	131
,, .	Islay, Eallabus	5·85	99	*Wick* .	Rathnew, Clonmannon	5·91	...
,, .	Mull, Benmore	12·40	...	*Carl* .	Hacketstown Rectory	6·33	154
,, .	Tiree	...	...	*Leix* .	Blandsfort House	5·44	148
Kinr .	Loch Leven Sluice	6·46	164	,, .	Mountmellick	6·56	...
Perth .	Loch Dhu	...	...	*Offaly*.	Birr Castle	4·35	132
,, .	Balquhidder, Stronvar	9·93	...	*Kild'r*.	Monasterevin	...	...
,, .	Crieff, Strathearn Hyd.	8·06	180	*Dublin*	Dublin, FitzWm. Sq.	3·87	156
,, .	Blair Castle Gardens	5·05	132	,, .	Balbriggan, Ardgillan.	4·52	156
Angus.	Kettins School	4·30	130	*Meath*.	Beauparc, St. Cloud	4·70	...
,, .	Dundee, E. Necropolis	...	...	,, .	Kells, Headfort	5·38	141
,, .	Pearsie House	5·49	...	*W. M* .	Moate, Coolatore	4·30	...
,, .	Montrose, Sunnyside	...	...	,, .	Mullingar, Belvedere	5·19	141
Aber .	Braemar, Bank	5·61	158	*Long* .	Castle Forbes Gdns.	5·61	141
,, .	Logie Coldstone Sch.	1·67	59	*Gal* .	Ballynahinch Castle	7·73	103
,, .	Aberdeen, King's Coll.	1·41	44	,, .	Galway, Grammar Sch.	...	...
,, .	Fyvie Castle	1·17	34	*Mayo* .	Mallaranny	8·70	...
Moray	Gordon Castle	1·68	62	,, .	Westport House	7·01	122
,, .	Grantown-on-Spey	...	...	,, .	Delphi Lodge	14·36	118
Nairn.	Nairn	1·86	84	*Sligo* .	Markree Obsy	6·32	132
Inv's .	Ben Alder Lodge	8·99	...	*Cavan*.	Belturbet, Cloverhill	4·17	113
,, .	Kingussie, The Birches	3·38	...	*Ferm* .	Enniskillen, Portora	...	...
,, .	Loch Quoich, Loan	14·10	...	*Arm* .	Armagh Obsy	4·94	158
,, .	Glenquoich	12·25	83	*Down* .	Fofanny Reservoir	10·26	...
,, .	Inverness, Culduthel R.	2·28	...	,, .	Seaforde	6·20	150
,, .	Arisaig, Faire-na-Squir	5·30	...	,, .	Donaghadee, C. Stn.	5·17	162
,, .	Fort William, Glasdrum	12·36	...	,, .	Banbridge, Milltown	4·24	147
,, .	Skye, Dunvegan	5·24	...	*Antr* .	Belfast, Cavehill Rd.	6·10	...
,, .	Barra, Skallary	...	...	,, .	Glenarm Castle	...	...
R & C .	Alness, Ardross Castle	3·26	79	,, .	Ballymena, Harryville	6·03	136
,, .	Ullapool	4·35	69	*Lon* .	Londonderry, Creggan	5·06	115
,, .	Achnashellach	8·75	87	*Tyr* .	Omagh, Edenfel	5·70	135
,, .	Stornoway	3·84	61	*Don* .	Malin Head	3·89	...
Suth .	Lairg	2·03	50	,, .	Dunfanaghy	5·30	...
,, .	Tongue	2·61	53	,, .	Killybegs, Rockmount.	4·09	56

Climatological Table for the British Empire, July, 1932

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Per-centage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London. Kew Obsy.	1012·5	— 3·3	84	46	70·3	55·2	62·7	0·0	57·2	84	7·4	2·45	+ 0·28	13	4·5	28
Gibraltar	1015·1	— 1·7	86	58	80·5	64·8	72·7	— 2·1	63·0	79	3·6	0·00	— 0·03	0	..	..
Malta	1013·8	— 0·9	88	66	81·6	70·5	76·1	— 2·2	70·2	77	3·5	0·00	— 0·05	0	11·1	77
St. Helena	1018·5	+ 1·6	62	52	59·6	53·7	56·7	— 1·8	54·6	94	9·2	5·42	..	24	..	..
Sierra Leone	1014·7	+ 2·0	87	69	81·3	72·2	76·7	— 1·9	74·9	93	9·3	31·99	— 3·59	24	..	..
Lagos, Nigeria	1014·5	+ 1·3	84	71	82·1	73·8	77·9	— 0·1	72·8	83	9·2	0·86	— 9·64	9	5·7	46
Kaduna, Nigeria	1015·2	+ 0·3	88	65	82·0	68·2	75·1	+ 1·5	70·3	86	9·0	2·66	— 7·96	11	4·7	37
Zomba, Nyasaland	1017·1	— 1·4	79	44	73·1	50·5	61·8	— 0·2	..	69	5·5	0·13	— 0·22	2	..	..
Salisbury, Rhodesia	1022·3	— 0·7	75	32	69·3	40·8	55·1	— 1·0	47·9	54	2·2	0·00	— 0·03	0	8·7	78
Cape Town	1021·9	+ 0·6	73	39	61·5	46·7	54·1	— 0·6	48·0	90	5·6	2·56	— 1·06	11	..	..
Johannesburg	1022·8	— 0·8	69	26	60·1	39·4	49·7	— 0·7	37·3	36	0·7	0·00	— 0·33	0	10·1	94
Mauritius	1019·3	— 1·1	76	56	74·8	62·2	68·5	+ 0·2	65·3	73	4·5	1·10	— 1·39	24	7·7	70
Calcutta, Alipore Obsy.	997·1	— 2·1	93	75	88·6	79·5	84·1	+ 0·4	79·8	91	8·9	9·87	— 2·83	19*	..	..
Bombay	1002·0	— 1·9	90	73	85·4	76·8	81·1	— 0·3	77·4	87	9·1	35·30	+ 11·03	24*	..	..
Madras	1003·3	— 1·2	100	76	96·0	79·9	87·9	+ 0·3	75·3	65	7·9	0·84	— 3·00	3*	..	..
Colombo, Ceylon	1008·7	— 0·4	87	71	85·2	76·9	81·1	— 0·1	77·0	79	7·4	1·56	— 2·87	10	6·8	54
Singapore	1008·5	— 0·4	91	70	87·1	75·7	81·4	+ 0·1	77·4	81	6·7	10·00	+ 3·21	12	6·6	54
Hongkong	1004·7	0·0	90	75	85·8	78·2	82·0	— 0·5	78·3	82	8·0	25·71	+ 11·29	23	6·1	46
Sandakan	..	..	90	70	86·9	74·9	80·9	— 0·9	76·3	84	7·6	9·68	+ 2·96	19	..	..
Sydney, N.S.W.	1016·6	— 1·7	67	38	61·6	44·4	53·0	+ 0·3	47·4	76	4·5	2·57	— 2·23	9	6·2	61
Melbourne	1018·1	— 0·8	62	33	55·7	42·0	48·9	+ 0·2	44·0	81	6·5	1·89	+ 0·03	19	3·7	37
Adelaide	1018·9	— 1·4	64	38	59·4	45·5	52·5	+ 0·7	47·9	75	7·3	2·64	0·00	19	4·2	42
Perth, W. Australia	1018·1	— 0·9	68	42	63·4	49·9	56·7	+ 1·5	51·5	74	6·6	9·72	+ 3·16	20	5·1	50
Coolgardie	1019·9	+ 0·1	76	33	61·7	41·1	51·4	+ 0·2	45·9	72	4·0	0·37	— 0·50	4	..	..
Brisbane	1017·8	— 0·6	75	42	68·9	47·7	58·3	— 0·2	50·4	65	2·5	0·27	— 2·01	5	8·4	79
Hobart, Tasmania	1017·5	+ 3·8	60	32	52·0	39·5	45·7	0·0	41·2	81	6·4	2·20	+ 0·02	10	4·1	44
Wellington, N.Z.	1016·3	+ 2·4	61	33	49·4	39·4	44·4	— 3·6	42·0	79	6·4	1·48	— 4·15	14	4·1	43
Suva, Fiji	1012·3	— 1·7	87	65	79·6	69·9	74·7	+ 1·3	70·8	83	6·3	15·04	+ 10·11	20	4·5	40
Apia, Samoa	1010·4	— 1·5	88	69	84·9	74·4	79·7	+ 2.5	75·9	76	4·5	2·42	— 0·56	15	8·0	70
Kingston, Jamaica	1013·5	— 1·2	92	71	90·2	73·7	81·9	+ 0·2	72·3	76	6·4	0·86	— 0·76	2	8·9	68
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1011·0	— 3·4	87	50	76·1	59·1	67·6	— 1·5	61·1	74	4·0	3·56	+ 0·72	14	8·6	57
Winnipeg	1013·3	+ 1·0	90	41	78·0	56·2	67·1	+ 0·7	57·5	87	4·9	2·46	— 0·64	12	9·4	59
St. John, N.B.	1008·3	— 5·3	81	49	69·0	53·3	61·1	+ 0·7	58·0	80	5·9	8·73	+ 5·10	20	6·8	44
Victoria. B.C.	1017·2	— 0·1	74	48	63·5	50·8	57·1	— 3·0	53·6	78	5·9	1·93	+ 1·51	11	7·7	49